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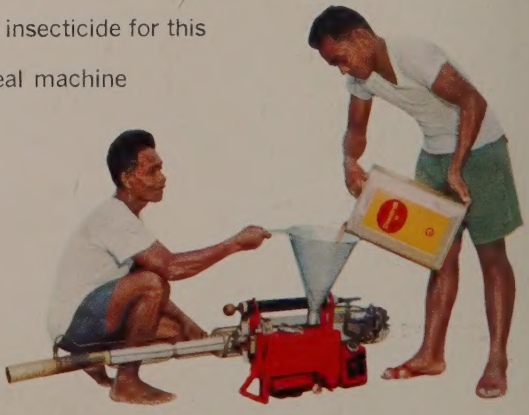

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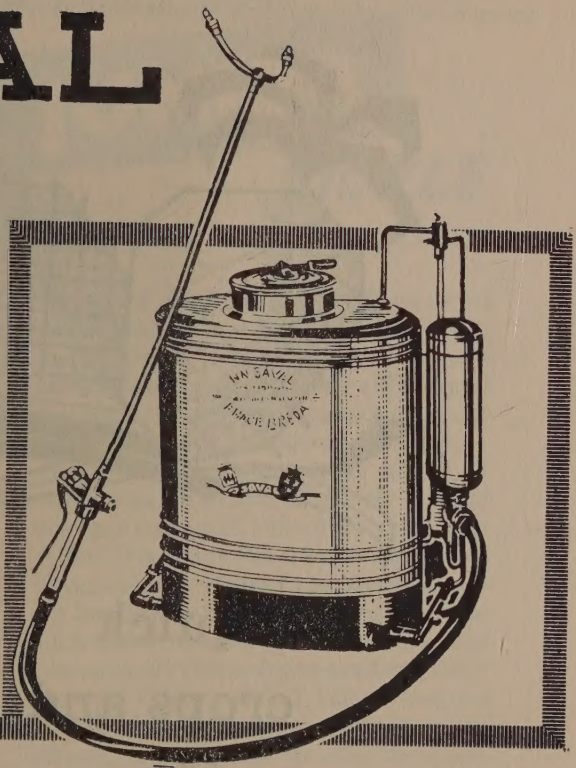

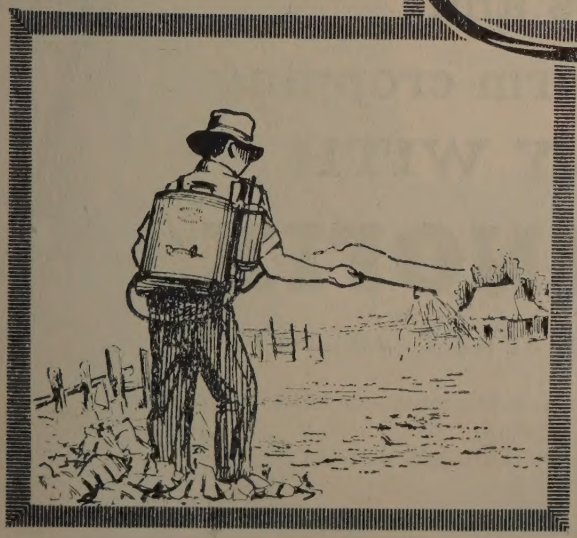

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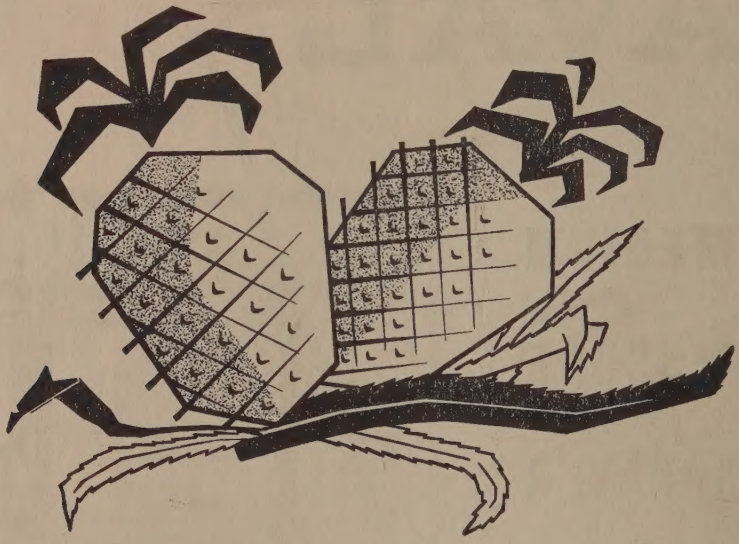

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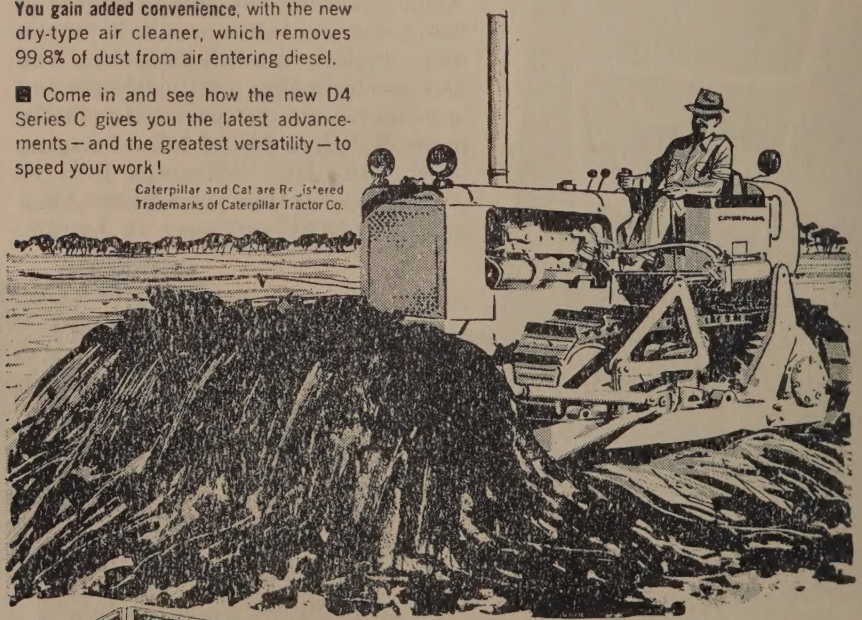

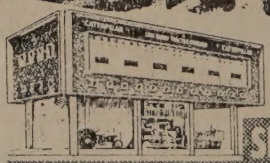

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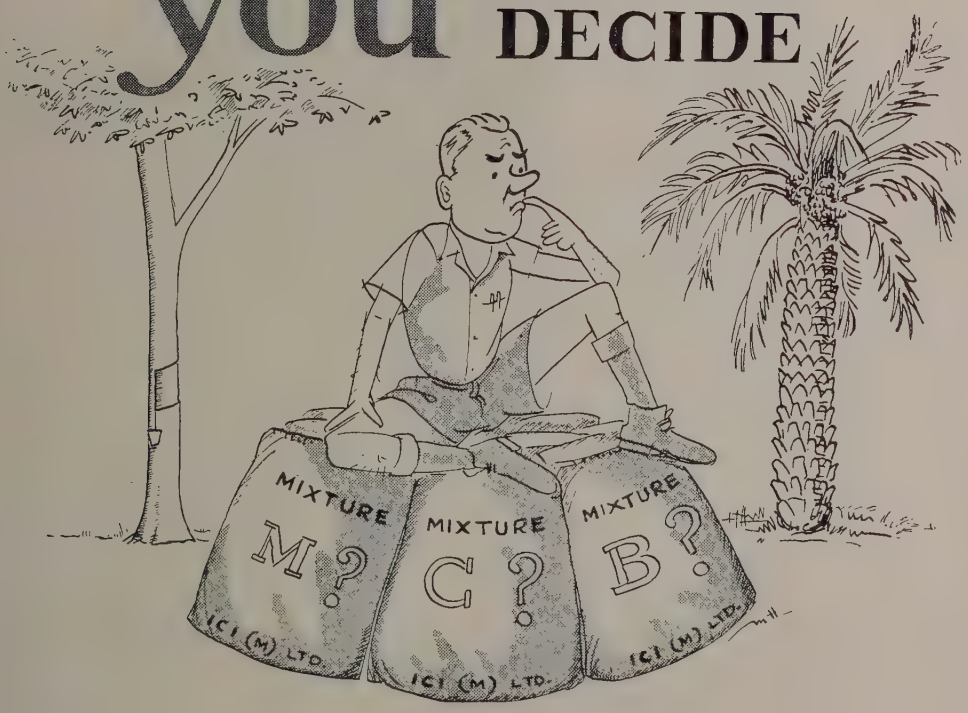

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Corrigenda

THE MALAYAN AGRICULTURAL JOURNAL

Vol. 43, No. 2

Page 117, line 27 "with an attacked leaf" read "with an attached leaf"

Page 118, line 7 "slightly retarted in growth" read "slightly retarded in growth"

line 25 "varietics in Maalya" read "varieties in Malaya"

Figures attached to article on page 117 Fig. 3 under (B) "flicking" read "flecking"

Fig. 4A & 4B: Arrows to point opposite directions.

Fig. 4B: "Healthy corilist Key lime sudling" read "Healthy control Key lime seedling"

THE

Malayan Agricultural Journal

Edited by the Publications Officer
with the assistance of the Publications Committee.

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THE MALAYAN AGRICULTURAL JOURNAL

The Journal is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extension work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

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THE

Malayan Agricultural Journal

Vol. 43, No. 2 — 1960/61

EDITORIAL

As intimated in the previous issue of the Malayan Agricultural Journal Vol. 43, No. 1, the 43rd volume of this journal will appear over a period of approximately 24 months instead of 12. Since the first issue, there have been certain difficulties beyond our control in producing the 2nd issue and we offer our apologies for the delay in compiling this issue.

Reconnaissance Soil Survey of Kelantan. The article, by Mr. Panton, on the soils of Kelantan, with its accompanying map is very timely in view of the considerable effort presently being expended on the opening up of previously undeveloped areas under the Government Rural Development Programme. The importance of utilizing the country's soil resources in the best possible manner has unfortunately sometimes been overlooked by the rural planners in the past who have not always fully appreciated the importance of soil type and fertility when planning development projects. Broad maps of the type prepared by Mr. Panton, should, if used correctly, lead to the development of a sound land use plan for the country as a whole, which will be of lasting benefit to the nation.

Phosphate Studies on Some Kelantan Soils. All the major padi soils of Kelantan contain very little available phosphate especially when compared with some of the padi soils elsewhere in the Federation. It is estimated that at least half of the area used for growing padi in Kelantan receives mixed fertilisers. Messrs. Kanapathy and Thamboo in their paper outline some of the result of their experiments carried out to determine the phosphatic status of these soils and the type of phosphatic fertiliser that is best suited to such soils. Their results would be most useful as a basis for further field experimentation to find out the best mixture of fertiliser to recommend to the padi farmers in this region.

Present Status of Rice Breeding. Food consumption in Malaya exceeds production and padi is the most important of her agricultural food crops. The policy of Government to close the gap between production and consumption of rice, the staple food of the country, has been pursued and the accent has been placed on achieving this target of self-sufficiency

by increasing production from existing padi lands rather than opening up new lands. Mr. T. K. Van, in this article traces the efforts of the Department of Agriculture in the fields of padi improvement through plant breeding from the cessation of World War II up to the present time. Throughout the article the close co-operation which exists with member countries of the International Rice Commission of the Food and Agricultural Organisation, United Nations to obtain the latest scientific thinking to speed up rice improvement is indicated.

Psorosis Virus A on Citrus. Psorosis, a virus disease of citrus, which has been responsible for the destruction of many varieties of citrus in almost all citrus growing areas of the world has been shown for the first time to be present in Malaya by Mr. Ting Wen Poh. Although only mandarin oranges have been proved experimentally to be affected by this virus, there is an indication that it is also present in the citrus growing areas of Telok Anson. This discovery is important in view of the growing importance of the citrus industry in the country and gives added urgency to the hopes for the establishment of a suitable certification scheme to ensure that only healthy materials are distributed to farmers.

RECONNAISSANCE SOIL SURVEY OF KELANTAN

BY

WM. P. PANTON,

Senior Soil Scientist.

Introduction

The following brief report and map present the results of a reconnaissance soil survey which was recently carried out in the State of Kelantan, one of the less highly developed Malayan States situated in the north-east corner of the Malayan Peninsula. The field work took place at intervals over a 3-year period between 1957 and 1959. The chief object of the reconnaissance was to examine and classify the soils of the State, so that an estimate could be made of the suitability for agricultural development of the different areas. Greater attention was given to the undeveloped portions of the State, but brief reconnaissances were also made within the main developed areas, so that the broad soil pattern could be determined and correlations could be made between soil types in cultivated and uncultivated regions.

Areas of potential agricultural land which appeared from topographic aspect to be most suitable for future development were examined in the greatest detail, while certain extensive areas of steep mountainous country which were obviously unsuitable were omitted from the field programme. It was not possible to prepare an accurate soil map for the mountainous central and southern portions of the State owing to the lack of accurately contoured topographic maps, but a number of exploratory river traverses carried out in these areas have provided much useful data which enables an assessment to be made of the agricultural potentialities of this extensive tract of sparsely developed country.

Several hundred miles of track and river were traversed during the course of the survey, and over 300 miles of *rentis* * were cut and examined in areas which were inaccessible by other means. The soils were examined at approximately one mile intervals during river traverses and at about ¼ mile intervals along roads and tracks, while examinations were made at much shorter intervals, frequently every 2 or 3 hundred feet, along rentis lines.

Geological data, which have been made freely available by the Director, Geological Survey, together with information deduced from existing topographic maps published by the Surveyor-General, have been incorporated in the soil map, and due acknowledgement is made to these sources.

* *Rentis:* A Malay term for a track or trace cut through the jungle. Those used in soil survey work are cut on fixed compass bearings.

The soils have been classified into series and associations, and the classification follows the widely accepted American system in which associations are defined as groups of soils which are geographically associated in a defined proportional pattern, while the individual soils within an association are known as soil series. A soil series is a more restricted group of soils which possess similar profile characters, and in practice an association is found to consist of two or more soil series. The association boundaries are reproduced on the 1 : 500,000 soil map facing page 102 while more detailed soil information has been plotted onto larger scale maps which are available for reference in the offices of the Division of Agriculture in Kuala Lumpur.

General Description

The State of Kelantan occupies the north-east corner of the Federation of Malaya, between North Latitudes 4° and 7°. Its total area is 5,746 square miles, or approximately 3,677,000 acres. The State boundary conjoins with those of the States of Perak, Pahang and Trengganu on the west, south and east respectively, while the northern boundary is marked by the Thai border and the South China Sea (Fig. 1).

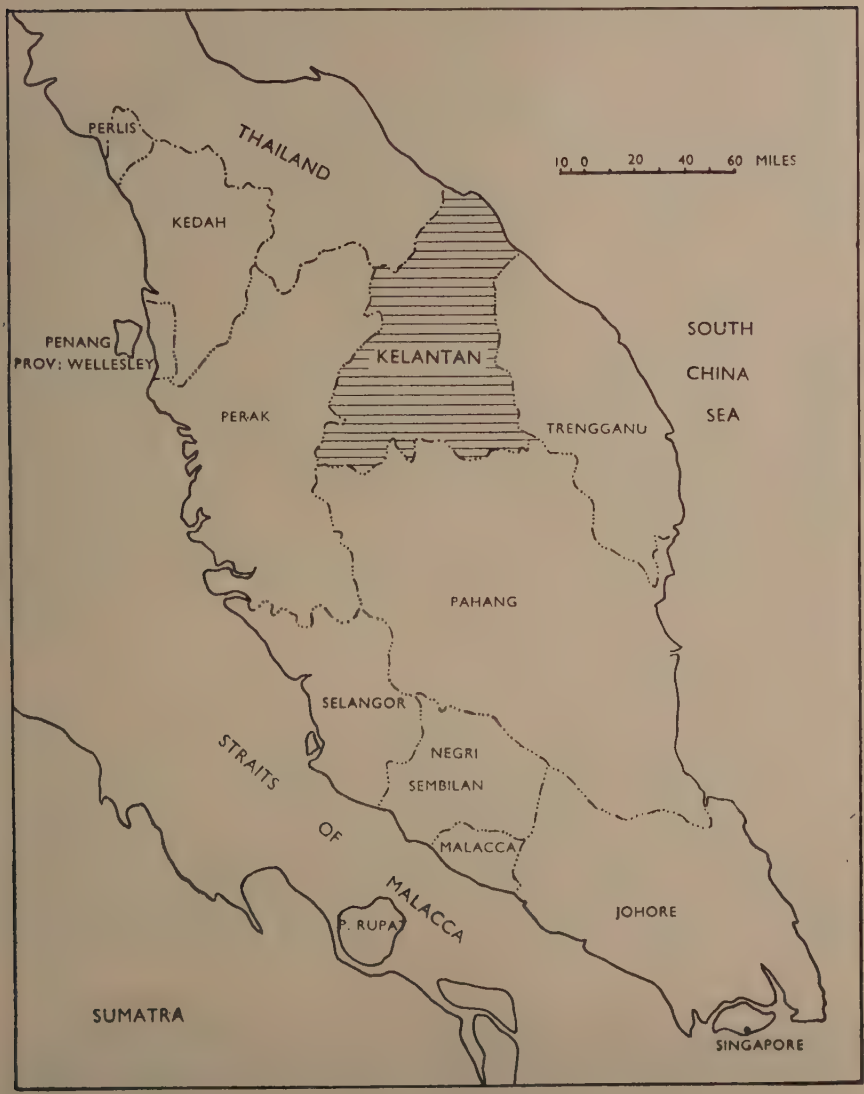
The total population, which amounts to 505,585 (1957) is concentrated mainly in the north along the coastal stretch, and on the lower reaches of the Sungei Kelantan, while smaller settlements are found along the railway line which runs through the centre of the State, and along one or two of the larger rivers, particularly the Sungei Golok, Sungei Pergau and Sungei Lebir. Small groups of Aborigines inhabit many of the less accessible parts of the State, particularly in the west along the Sungei Nenggiri and its tributaries.

With the exception of the coastal stretch and the basin of the Sungei Kelantan most of the State is very undulating, and several impressive mountain ranges reach up to 5,000 feet or more, particularly in the border regions. Well over half the state lies 500 feet or more above sea level. Most of the easily accessible areas of low elevation have already been developed for agriculture and very few areas of gentle topography still remain under their natural forest cover. Contrary to general opinion Kelantan does not have huge reserves of land suitable for agriculture, and there is a probability that increasing land pressure will force cultivators onto steeper and steeper slopes in future years unless existing legislation is effectively enforced. There is a serious danger of erosion on the hills and consequent silting up and flooding in the richer areas of cultivated alluvial land if felling and cultivation is allowed to continue unchecked, and a study of the whole question of steep slope cultivation and the drawing up of an agreed State policy on this matter appears to be an urgent requirement.

Agriculture is the chief means of livelihood for most of the population, who either work their own smallholdings, principally of padi or

FIGURE I

Sketch Map of Malaya showing Position of Kelantan



rubber, or obtain employment on neighbouring rubber estates, particularly in the Kuala Krai district. Fishing is an important industry along the coast.

Road communications are highly developed along the coastal stretch and in the region between Kuala Krai and Kota Bahru (Fig. II) but in other areas where vehicular tracks exist they are, with one or two notable exceptions, hardly suitable for light vehicles. The railway line running southwards from Tumpat to the Pahang border is the main communicating link with the west coast of Malaya, and development in the interior is confined chiefly to the route followed by this line. Rivers form the main access routes to the remainder of the interior, and most of the larger streams are navigable by small craft, many of which are powered by outboard motors capable of taking the boats up the less treacherous rapids. Foot tracks are common in and around the main aborigine settlements, but are not numerous over most forested areas, and progress in the jungle is usually very slow and tedious. The climate at low elevations is hot and humid, with a slight dry season about the middle of the year and a pronounced wet season between November and February. Seasonal variations are most marked in the coastal districts. Annual rainfall in most districts is between 100 and 140 inches with the higher rainfall occurring on the east, while maximum and minimum day temperatures at sea level are in the order of 90°F and 72°F respectively. The broad soil pattern is not very complicated, and the composition of the parent rock is the main factor conditioning the soil type developed in any one place, while the topography is an important subsidiary factor which determines whether a juvenile or mature type of profile will be developed from a particular parent material. These two factors are discussed more fully below.

Topography

As a glance at the small scale map of Kelantan (Fig II) will show, the boundary of the State almost entirely coincides with the catchment boundary of the Sungei Kelantan river system, the only exception to this rule being along the Thai border, where the Sungei Golok, which forms the international boundary, flows directly into the South China Sea, and along the coast where a number of small streams drain the narrow coastal plain and adjoining hills in the Pasir Puteh and Bachok districts.

In the mountainous and hilly region, which includes much the greater part of the State, the main rivers have cut deep valleys into the hills and the rugged nature of the topography makes travel in any direction except along the stream banks or the ridge tops a most arduous undertaking. In general almost all the land above the 250 or 300 foot contour is steeply sloping and well in excess of 20°, the only important exception to this rule being the large valley of the upper Sungei Libir—

Sungei Aring river system in which most of the land lies at an altitude of about 500 foot.

In the middle reaches of the Sungei Kelantan and the lower reaches of its main tributaries, the rivers have carved out valleys which vary in width from a few hundred feet to several miles across. The valley bottoms are generally strongly sloping to moderately steep, while small intermittent stretches of flat land occur close to the river banks.

The Sungei Kelantan has built up a wide flood plain which is contiguous with that of the Sungei Golok on the west, and with the coastal plain which runs as far as the Trengganu border on the east. This land is almost flat and constitutes the main padi growing area, which contrasts sharply with the undulating country in the valley tract of the river and the adjoining foothills, which are the main agricultural areas for crops other than padi.

Parent Materials

The most important parent materials are alluvium, granite, shale and quartzite, while rocks of lesser importance as soil formers include schist, limestone, conglomerate, andesite and a variety of other volcanic rocks which vary in composition from acid to basic. The distribution pattern of these rocks is somewhat complex and detailed geological surveying, which has been in progress for several years, should lead to the eventual production of a much improved map, but at the present time the most recent published data for Kelantan are shown on the 1948 Geological Map of Malaya, which was compiled mainly from pre-World War II survey information.

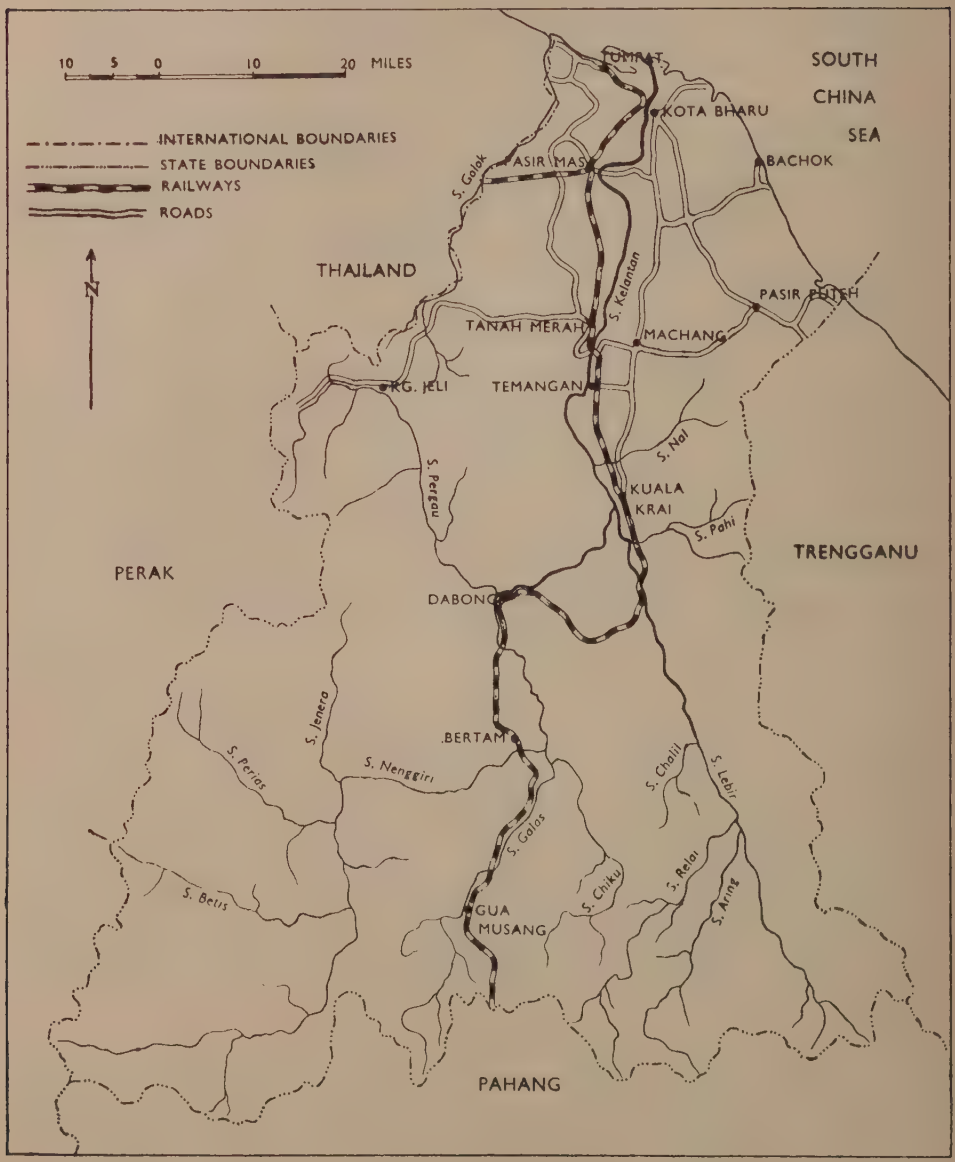
Most of the rocks mentioned above weather to produce quite good soils, with the exceptions of the coarse coastal deposits on which the soils are highly leached and of very low fertility, and the limestones, which weather to form very steep-sided hill masses which are almost bare of soil. There is also an area of shales and quartzites to the north-west of Tanah Merah which has weathered to produce a rather infertile lateritic soil type, while the alluvial soils adjoining this area are also extremely poor and have probably developed over alluvium derived from the lateritic soil group. The probable composition of the parent materials from which the various soils are derived are noted in the soils series descriptions which are included in this article.

Vegetation

The natural vegetation over most of the State is Dipterocarp rain forest except in some lowlying situations along the coast where this gives way to swamp forest, often characterised by Gelam (*Melaleuca leucodendron*), which occurs in many of the coastal swamps, and probably had a wider distribution in former times prior to the opening up of large areas of alluvial soil for padi cultivation.

FIGURE II

Sketch Map of Kelantan showing Main Communication Routes



The main crops cultivated at the present time are padi, which is grown chiefly on the flood plain of the Sungei Kelantan and the inland sedentary soils further inland. All other crops including coconuts, tobacco, and various local fruits are of minor importance and do not feature largely in commerce, except on a very local scale.

Soil Descriptions

In the following paragraphs the soils occurring in the main groups shown on the map are briefly described, while the general suitability of these soils for large scale development is commented upon. It is hoped that the information given in this report and the accompanying map will be a useful guide to the State and Federal Governments in planning for future land development.

Table I

Approximate Acreage Table of Kelantan Soil Associations

Steep mountainous and hilly land considered unsuitable for extensive agricultural development (largely unsurveyed)	2,776,000	acres
Rengam Association	165,000	,,
Durian Association	203,000	,,
Batang Merbau Association	64,000	,,
Tandak Association	21,000	,,
Serdang Association	4,000	,,
Segamat Association	6,000	,,
Kuala Brang Association	1,000	,,
Deficiency Association	55,000	,,
Inland Swamp Association	28,000	,,
Rudua-Rusila Association	44,000	,,
Main Plain Association	310,000	,,
Total Area of State	3,677,000	acres

Steep Mountainous and Hilly Land Considered Unsuitable for Extensive Agricultural Development

A very high proportion of the State, amounting to about 76 per cent of the total land area, falls into this group. It includes practically all land above the 400 foot contour, except in the upper Sungei Lebir basin, where less steeply sloping land occurs at a slightly higher elevation.

Most of this area consists of very mountainous country, particularly in the areas to the west of the railway line, and along the Trengganu and Pahang borders, and slopes can be expected to exceed 25° in practically all areas. The area between the railway and the Sungei Lebir is not so rugged, but even here the country is very broken

and undulating, and slopes in excess of 25° will be the general rule. Small pockets of less steeply sloping land in which slopes may fall into the 10 to 25° slope range will occur in many valleys along the banks of the larger streams, but continuous areas of more than 500 acres will be very rare, and no suitable sites for large development schemes can be expected to occur in this land group, with the possible exception of an occasional site at high altitudes which may lend itself to development as a hill station. The exact location and area of any potentially suitable development sites will be apparent only when contoured topographic maps become available. The soils in these areas, which are developed from granites, quartzites, and shales, are mostly shallow immature types, but it is the slope rather than the soil type which makes these area unsuitable for cultivation, and the soils have not been studied in any detail.

Rengam Association

This association consists of soils developed from granite and allied rock types, including gneisses, which are developed over the less steeply sloping areas. The soils occur chiefly in the foothill regions of the main mountain ranges, and along the bottoms and lower sides of many of the larger valleys. They are normally deep, medium textured soils with uniform profiles and of moderate to moderate high fertility. Soils of the Rengam series are the commonest and these probably cover about 90% of the total area, while small developments of the Jerangau series, which is a rather better soil with a heavier texture and more friable structure, occur in patches. The soils in this association are normally developed over strongly sloping to moderately steep land in the 5 to 20° slope range. The fertility is a little above average, by Malayan standards, and most areas shown on the map are likely to prove suitable for large scale agricultural development with a wide range of tree crops.

Durian Association

This association is very widespread in the central and southern parts of the State. It is developed over a mixed geological formation of shales, quartzites, and limestones, with small outcrops of volcanic rocks, and several soil series of somewhat variable character exist within it. The association occurs mostly in the valleys of the main rivers. Soils of the Durian series are the most common, and these are mainly silty clay loams and silty clays of moderate depth characterised by rather stiff consistencies in the subsoil horizons. Very occasionally a few small laterite concretions may occur, while decomposed shale parent material usually appears at a depth of a few feet. It is a soil of average fertility, probably a little less fertile than the Rengam, which is generally suitable for rubber and is likely to suit a variety of other crops in some of the more favourable locations. A rather less fertile soil, known as the Batu Anam series, occurs in small patches, particularly in the south of the State near the Pahang border. This soil, which is rather paler

in colour and likely to be less fertile than the Durian series, is best suited to rubber, and the growing of other crops would be better avoided if at all possible. Another soil series which occurs in this association is the Segamat series which is a deep, red coloured, well structured uniform clay to clay loam developed from the more basic volcanic rocks which occur interbedded with the shales, but these soils unfortunately have a restricted distribution, and are usually found only in small patches of less than 100 acres. They appear to be most common in the lower Sungei Libir valley. The Segamat soils are definitely above average by Malayan standards, and, where practical, a policy of developing such soils with crops other than rubber should be worth pursuing.

Another soil type, which occurs only in small amounts confined to the Kuala Krai area, has been named Kemuning series. This is an unusual soil with a characteristic greenish grey colour, which is believed to develop over a type of carbonaceous shale. It has a silty clay loam or clay loam texture, and a rather shallow profile in which root development is not particularly good. Very little is known of the fertility, but it is not likely to be high, and rubber is probably the best crop to recommend for this soil until more is known regarding its potentialities.

In the area where limestone is the dominant rock type the parent rock may either occur on the surface in the form of steep-sided massive blocks towering perhaps 1,000 feet or more above the level of the surrounding country-side, or in other instances the limestone may have been removed by solution and the parent rock is covered by a layer of alluvial material which has been deposited by streams flowing over the area in relatively recent geological times. The topography in these latter areas is flat or gently sloping and the alluvial soil is normally a rather pale coloured sandy or silty clay or clay loam with a stiff consistency. These alluvial coverings are usually only a few feet deep, and the soils developed on them appear to be of below average fertility. The moisture contents of these soils probably varies considerably through the year, and serious drought conditions set in during periods of low rainfall, probably due to the rapid drainage through the limestone bedrock. Very little examination of these soils has been carried out in Kelantan, where they have a rather restricted distribution, but the biggest known area, near Mentara Halt on the Pahang-Kelantan border, is unlikely to prove suitable for large scale agricultural development.

In Table II below analysis details are given for a typical profile of the Durian Series, which is the commonest sedentary soil occurring in the State. The results given in this table are fairly representative of those obtained on most normal Kelantan sedentary soils.

Batang Merbau Association

The Batang Merbau association is confined to an area between the Thai border and the Sungei Kelantan, to the west and south of Tanah

Table II

Analysis of Durian Silty Clay Profile

Reference Number R.I. 649

Depth (in.)	Clay <.002 mm.	Silt .002-.02 mm.	Fine sand .02—.2 mm.	Coarse sand .2-2 mm.	Gravel 2-10 mm.	Stone in Original >10 mm.	pH	Loss on Ign. %	O.M. %	C. %	N. %	C/N. Ratio	Available	
													P_2O_5 p.p.m.	K_2O p.p.m.
0- 1"	56	25	11	8	Nil	Nil	4.7	12	5.38	3.12	0.27	11.6	13	170
1- 6"	66	25	4	5	„	„	4.5	6	1.10	0.64	0.09	7.1	4	80
6-12"	68	23	5	4	„	„	4.6	5	0.79	0.46	0.06	7.7	2	95
12-18"	70	23	4	3	„	„	4.6	5	0.53	0.31	0.05	6.2	2	105
18-28"	72	23	2	3	„	„	4.5	5	—	—	—	—	0	80
28-32"	74	21	3	2	„	„	4.6	6	—	—	—	—	2	100
32-36"	74	21	3	2	„	„	4.4	6	—	—	—	—	2	113

Note:—In this table values for available phosphorus were obtained by extraction with Ammonium fluoride and HCl at pH 1.8 followed by colorimetric estimation, and available potassium by extraction in N/2 acetic acid (ratio 10 : 1) followed by estimation in the Langé flame photometer.

Merah. The soils are developed from schist, which is frequently interbedded with quartzite, and the soil type is closely related to the proportion of admixed quartzite which occurs in any one place. The most common soil, called the Batang Merbau series, is a deep, brownish yellow or strong brown coloured fine sandy loam or fine sandy clay loam with a rather friable consistency. It is a soil of average to somewhat above average fertility which should be suitable for a wide range of tree crops. Near the north boundary of this association, particularly in the north part of the Kemahang North Forest Reserve, this soil becomes noticeably poorer and more variable, and further detailed survey in this area is likely to reveal the need for at least one other soil series which will be of marginal suitability for large scale agricultural development even with rubber.

Tandak Association

This association consists largely of one series, the Tandak series, which is a laterite soil with a very shallow topsoil over-lying the laterite horizon. It is a poorer lateritic soil than the Malacca series soils, which are commonly found in the western States of Malaya, due to the much shallower topsoil horizon which overlies the concretionary layer. It occurs over an area of about 21,000 acres in strongly sloping low hill country on the edge of the alluvial plain between the Sungei Golok and the main railway line. Much of this area lies in the northern part of the Kemahang North Forest Reserve, while most of the remainder is under smallholders' rubber.

In many places the topsoil has been largely removed by erosion as a result of many years careless cultivation and is now in a seriously degraded condition, with laterite surface pavements made up of loose concretionary gravel. Even under undisturbed forest the topsoil is often shallow, and in many places within the forest reserve the topsoil cover overlying the laterite horizon is as little as 3 or 4 inches thick. While the soil will support rubber it is unlikely to be of high quality, and further agricultural development should be avoided as much as possible in this association. In the northern part of the area, close to Rantau Panjang, the laterite band occurs at a greater depth from the surface, and the topsoil is rather better, but the remaining areas appear more suited to forest development than to agriculture.

Serdang Association

This association occurs only in the north of the State, south of Rantau Panjang and close to the Sungei Golok. The Serdang series soil, which is much the commonest soil occurring in this association, is developed from quartzite which is well exposed on the sides of Bukit Kwang, a prominent hill in the centre of the area. This soil is a rather fine sandy type with a loose consistency and weak structure. It is a common soil in many other parts of the Federation, particularly Selangor

and Perak, and the types found in Kelantan are more sandy and lighter textured variants of the normal series, and as such are likely to be rather less fertile than soils of the same series occurring in other parts of the country.

Segamat Association

The Segamat series is the commonest soil occurring in this association. It is a rich soil, with a deep and uniform profile, good crumb structure, and characteristic red or yellowish red colour. It is derived from andesite, a basic volcanic rock which forms the dominant parent material of the soils in the area of the Temangan Forest Reserve. Very little actual soil examination has been carried out in this area, and the boundary of the association has been inferred largely from geological data supplied by officers of the Geological Survey. It is possible that further soil examination will reveal more than one soil type in this area, but from what is known of the Segamat series in other parts of the country it seems reasonable to expect the soils to be of above average fertility in the area shown on the attached map, and the suitability of the area for crops other than rubber is worth serious consideration. Small developments of the Segamat series also occur within the Durian Association, as noted above.

Kuala Brang Association

The soils found in the small area of this association are similar to a more widespread group of soils in Trengganu. Soils of the Kuala Brang series which are medium textured loams of moderate depth and average fertility, are the commonest, but a few shallow laterite soils (Malacca series) also occur in small amounts, particularly along the main road. The total area is very small, the soils being confined chiefly to the slopes of a low ridge close to the road, and there are no large areas suitable for future development.

Local Alluvial Soil Association

This covers a wide range of soils developed over alluvial deposits found along the valleys within the main sedentary soil associations. The soils normally possess high water-tables and develop pale grey colours, with various degrees of mottling in the upper horizons. The textures are variable, and usually show similarities with the textures of the surrounding sedentary soils, the eroded material from which they have been formed. The soils are distributed in long narrow strips along the streams within all the sedentary soil associations shown on the map, but owing to the small scale of the map it is not possible to show the boundaries of this group. The soils are variously suitable for padi or for crops requiring more free draining conditions, and their use is largely determined by the ease with which drainage or irrigation measures can be effected.

Deficiency Soil Association

The deficiency soil association covers a large area to the west of the railway line between Pasir Mas and Tanah Merah. The soils were examined in detail a few years ago by G. W. Arnott, who identified and mapped a number of series. Pot experiments carried out on selected soils showed them to be deficient in phosphorus, magnesium, calcium and minor elements but they were nevertheless considered to be variously suitable, if fertilised, for a variety of crops including dry padi, rubber, pineapple, and fruit trees including citrus. However, in view of the rather infertile nature of these soils, and the more obvious suitability of most other soils in the State it would be wise to avoid large scale development in this area until field experimentation has shown the growing of these crops to be an economically feasible proposition.

Inland Swamp Association

Small areas of peat swamp occur in a few places within the main alluvial associations, and the positions of four of the largest areas are indicated on the attached map. These peats, which form in waterlogged depressions in the alluvial platform, or in old lagoonal basins cut off from the sea by coastal beach accumulation, have not been examined in any detail as their potentialities for development are considered to be very low. The peat is likely to be deepest near the centres of the swamps, while the soils around the margins are generally shallow mucks or dark organic clays. Experiments have been carried out for a number of years on similar soils at Batu Rakit in Trengganu. Although improvements have been effected through addition of fertilisers, the results of these experiments have so far not been sufficiently encouraging to warrant large scale development.

Main Plain Association

This association includes a large number of series which have been mapped in detail by A. R. McWalter, who has recently carried out a detailed-reconnaissance soil survey over much of the area. The soils vary from free draining, light textured, recent river terrace types to heavy clays with impeded drainage and very acid subsoils. The different soils are suitable for a variety of crops, including wet and dry padi, tobacco, maize, leafy vegetables, fruit trees and rubber, and each series is generally characterised by one or other of the above crops, or sometimes by a combination of these. As this area is already intensively developed very little attention was given to the soils during the schematic-reconnaissance soil survey carried out by the author, and full descriptions of the soil types will be given in a later publication.

Rudua-Rusila Association

This association occurs in a narrow band along the coast, which is broken by the mouth of the Sungei Kelantan and a number of smaller streams.

The soils are extremely poor and include two strongly contrasting types, one, the Rudua series, being a very free draining, loose, highly leached sandy soil which occurs over long narrow ridges running parallel to the coast, while the other, called the Rusila series, is a waterlogged, dark coloured swamp soil which occurs in the depressions between adjacent sand ridges. The sandy ridges consist of deposits of beach sand which have been built up in geologically recent times by wave action, which has possibly been accompanied by successive rises of the land in relation to the sea level, while the intervening lagoons have been gradually filled with finer material carried in by streams which flow between the old beaches before finally breaking through to the sea. Many of these small swamps contain extremely woody deep peats.

Both types of soils in this association are very poor, and the area as a whole has very low development potentialities. Coconut and cashew are the only crops which would appear suitable for large scale cultivation on the sandy ridges, while padi, which is the only crop worth considering on the swampy soils, is unlikely to give worthwhile economic yields.

Summary and Conclusions

Soil survey has shown that the less steeply sloping sedentary soil areas in the interior belong mainly to one association, consisting mainly of one series, the Durian series, which is a soil of average fertility, together with at least two other soils, namely the Segamat and Kemuning series, which are derived respectively from basic volcanic and carbonaceous shale rocks, and occurring only in small patches within the dominant series in a few areas. All of these soils are considered to possess average or slightly above average fertility, and provided the topography is not too steep practically all areas where these soils occur can be considered suitable for rubber and dusun. The possibility of growing oil palm on these soils would also be worth considering, and small observational plots at a few selected sites would be advisable if alternative crops to rubber are considered desirable.

The Rengam Association is another group of soils of somewhat above average fertility which occurs in several parts of the State and can be usefully cultivated with a variety of crops including rubber, dusun and oil palm, while the Batang Merbau Association is a group of somewhat above average fertility which is already largely developed, but small undeveloped areas still exist in a few places.

The Tandak Association is occupied partly by forest reserve, while much of the remainder is already largely developed. These soils appear to be the poorest of the sedentary soil types and they do not appear to be particularly promising for development. Their continued use as forest reserve is probably the best land use policy to pursue in these areas.

The group of soils constituting the Deficiency Association has been surveyed previously in some detail by Arnott who found them to be deficient in phosphorus, magnesium, calcium and minor elements but nevertheless considered them to be variously suitable, if fertilised, for a variety of crops including dry padi, rubber, citrus and other fruit trees, and also pineapples. However, in view of the rather infertile nature of these soils and the more obvious suitability of most other soils in the State it would be wise to avoid large scale development in this area at least until field experimentation has shown the growing of these crops to be an economically feasible proposition.

The soils mapped as Serdang and Kuala Brang Associations occur only over limited areas, and most of the available land in these groups is already alienated. The Segamat Association contains soils of definitely above-average fertility, but the only unalienated areas within this group now lie within gazetted forest reserves.

The rather complex soil pattern in the highly developed alluvial plain was not examined during the present survey, but a soil survey of this area is now in progress and the results will be presented in a separate report. Sufficient is known about the soils, which are grouped as Main Plain Association on the soil map, to indicate that practically the whole of the area is intensively developed and no large unlienated reserve occurs within this group. The large inland swamps which occur near the coast and along the western side of the Kelantan plain contain very acid peat soils and do not appear to make very attractive development propositions, while the soils of the Rudua-Rusila Association, which have formed over a series of raised beaches are also very poor and offer few possibilities for intensive agriculture.

The map illustrates very forcibly the huge area of steeply sloping mountainous and hilly country which occurs in Kelantan, and the percentage of land in this category in proportion to the total area of the State is higher than that of any other State in the Federation. The potentialities for agricultural development are not as great as many people believe, and except for the main plain and its immediate hinterland, together with a few of the larger valleys, the greater part of the State appears more suited to forestry development. Aboriginal, game and recreational reserves are other extensive uses to which much of the land appears best suited.

A logical system of alienation in Ulu Kelantan might include retention of the existing aborigine reserves, while most of the remaining areas, which contain a high proportion of potentially workable timber, could be gazetted as forest reserve, or placed within the jurisdication of the Game Department for use as game sanctuaries or for recreational purposes. Increasing population pressure in an essentially agricultural State such as Kelantan is bound to result in agitation for excision of

reserves such as those mentioned above, and a scientific appraisal of the probable consequences, and experimentation into the practicability of cultivating steep slopes without danger of erosion would be worth carrying out in some detail at the earliest opportunity, either at a State or Federal level, and not delayed until the problem becomes acute. The question of mining reserves must be considered separately, and left open to review as the results of geological surveying and prospection are made available.

It has been suggested that the Aborigine system of shifting cultivation is injurious to the land and wasteful of the countries soil resources, but except for the obvious spoilation of possibly utilizable timbers, this is not borne out by observational evidence, for erosion does not take place to any great extent on even the steepest aborigine clearings, except along the path-ways, or on the bare areas beneath the house sites, and this absence of serious erosion damage can be attributed to the very temporary nature of the clearings, the thick weed cover which soon colonises the area after a burn, and the small amount of disturbance made to the surface soil into which the crop seeds are dibbled. It is interesting, and perhaps ironical to note that such practices as these are the opposite of those characterised by most modern and progressive systems of cultivation, but such methods will only work effectively when the population density is low, and continuation of these time-honoured methods in an area where the population is increasing at a rapid rate could well be ruinous to the land, and ultimately to the people themselves who depend on the soil for their livelihood.

Large scale agricultural development outside existing developed areas will almost certainly be confined to the Sungei Pergau region and the lower Sungei Lebir valley tract, due to the absence of suitable land in other parts of the State. The remote valleys of the upper Sungei Lebir and the Sungei Aring offer some hope for expansion in the more distant future, but although the soils are believed to be favourable for agricultural development, an exact estimate of the potentialities can only be made after the area has been accurately mapped. There appears to be little likelihood that Kelantan will ever be in a position to offer large tracts of suitable agricultural land to the surplus populations of the other land-hungry States of the Federation.

In conclusion it must be emphasised that the attached map is a schematic-reconnaissance map in which the standard of accuracy is not the same throughout, and it should be interpreted with full regard to its limitations. The accuracy of much of the data could be improved by further survey work, but the lack of accurate topographic maps for much of the interior of the State is a serious handicap to detailed soil mapping at the present time.

KELANTAN

SCHEMATIC RECONNAISSANCE SOIL MAP

1st. Edition, 1960

Published conjointly by the Director of Agriculture and the Director of Geological Survey, using base maps supplied by the Surveyor - General, Federation of Malaya.

Scale 1 : 500,000 or 7·89 Statute Miles to 1 Inch

Miles 10 5 0 10 20 30 40 Miles

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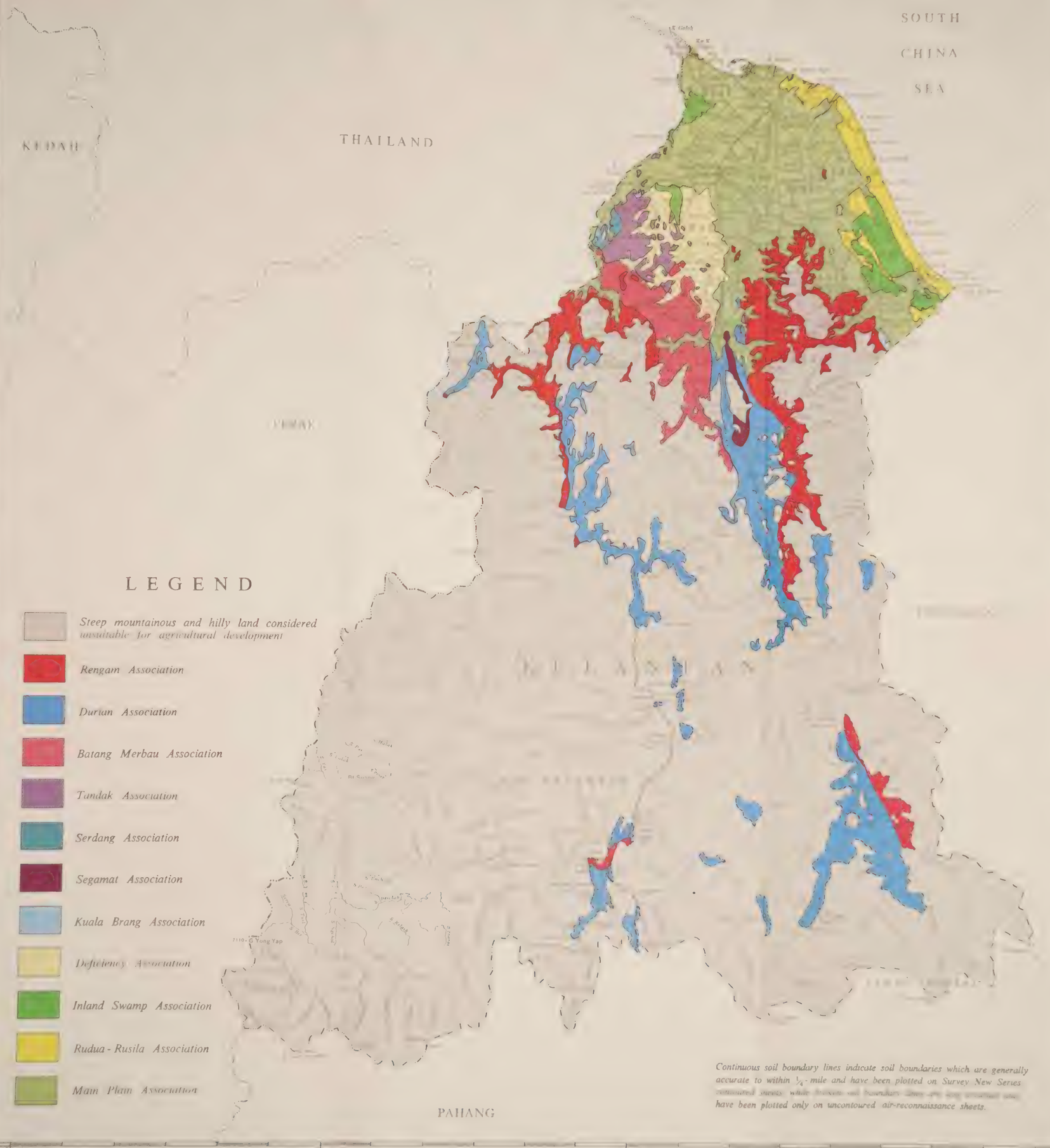

101 00' E. of Greenwich

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The hard work put in by a large number of boatmen, guides, labourers and porters is also noted with appreciation.

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PHOSPHATE STUDIES ON SOME KELANTAN PADI SOILS

BY

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Introduction

In a padi manurial trial on smallholders land in Kelantan, Ashby found that a fertiliser mixture consisting of Sulphate of Ammonia, Super Phosphate and Muriate of Potash gave a good yield response (1). Even prior to this work, Kelantan farmers had been using wood ash (Baja Bakar) and fish offal to fertilise their padi fields and these supplied nitrogen, phosphate and potash. By 1960, the application of artificial fertiliser had become so popular that Vivian estimated that at least half the area used for growing padi in Kelantan had received at least 100 lbs. of the recommended fertiliser mixture (2). This mixture (Baja padi) was made up as follows:—

24 lbs. N as Sulphate of Ammonia
10.4 lbs. P_2O_5 as Double Super Phosphate
13.6 lbs. P_2O_5 as Christmas Island Rock Phosphate
12 lbs. K_2O as Muriate of Potash.

The Senior author took samples of padi plants from Kelantan during the 1959-60 season and found that very few areas had not received fertiliser. Some farmers had used 200 lbs. per acre of the recommended mixture, others only 100 lbs. and still others had used only wood ash and fish offal. It is obvious, therefore, that nitrogen and phosphate fertilisers in some form or other are used extensively by Kelantan farmers. In 1959, samples were taken of the Kelantan soils surveyed by McWalter (3) in order to determine their fertiliser requirement. Apart from a general study of the samples, two pot experiments were conducted to estimate the phosphate status of the soils and the type of phosphate fertiliser required.

Materials and Methods

The major padi soils of Kelantan were sampled by collecting specimens from the top 5 inches at more than 100 points in each soil series. These were put into sacks and brought to Kuala Lumpur where they were dried, pounded and passed through a half-inch sieve. Fifteen pounds of this soil was put into each plastic pot of 2 gallon capacity.

Experiment No. 1

In this experiment there were two levels of fertiliser application—nil and complete (except phosphate)—with three replications. The soils under test were identified as follows:—

1. Batu Hitam
2. Tok Yong
3. Lubok Itek
4. Kampong Tipus

5. Pasir Puteh
6. Deficiency area
7. Byan Pyas *

(* The Byan Pyas soil is a fertile virgin soil still under swamp jungle from the Lower Perak District and this was included for comparison).

The 'complete' mixture was made up from:—

Urea, 0.3 gms per pot at transplanting and 0.3 gms after 4 weeks (= 1 cwt/acre).

Magnesium lime, 6 gms per pot 3 weeks before transplanting (= 10 cwt/acre).

Potassium Sulphate, 0.6 gms per pot (= 1 cwt/acre).

Trace elements:—

Copper Sulphate	....	35 mg per pot
Manganese Sulphate	....	140 „ „ „
Ferric Chloride	....	280 „ „ „
Ammonium Molybdate	....	7 „ „ „
Boric acid	....	7 „ „ „

No zinc was added as it was known that rain falling onto the plants from the galvanised wire netting used for the padi cage provides considerable amount of zinc. Potash and the trace elements were added three days before transplanting and the pots were then flooded. Two 24-day old seedlings (variety Pebifun) were planted in each pot and the pots were arranged at random in the padi cage. Tap water was used for watering when rain was insufficient. The tap water was analysed and found to contain extremely little plant nutrient.

The plants were uprooted at maturity and the basal parts washed thoroughly before the roots were cut off. The aerial parts were then dried in a hot-air stream and the weight of dry grain and straw determined. Nitrogen, phosphate and potassium analyses were carried out on the dry material by the usual methods adopted in this laboratory. The results are given in Table I (the average for three pots). It can be deduced from Table I that the phosphate available to plants in the various soils is approximately as follows:—

Kelantan Soil Series or location	Phosphorus taken up by the plant (mgs)	Kedah Soil Series or location	Phosphorus taken up by the plant (mgs)
Batu Hitam	29.5	Kuala Kedah	203.7
Tok Yong	47.2	Pengkalan Kondor	100.8
Lubok Itek	24.9	Telok Chengai	46.6
Kampong Tipus	27.6	Tualang Idris	78.8
Pasir Puteh	25.7	Kangkong Sedakka	33.4
Deficiency area	21.8	Kuala Perlis	65.6
Byan Pyas (Perak)	97.5	Kanggar	73.7
		Tg. Karang (Selangor)	317.0

NOTE:—The figures for Kedah soils (without additional fertiliser) are taken from a similar pot experiment and are given simply for comparison.

Table I

	Straw—Dry matter basis					Grain—Dry matter basis					Total (Grain & Straw)		
	No. of tillers	Wt. of straw gms.	% N	% P	% K	No. of ears.	Wt. of Grains gms.	% N	% P	% K	Uptake of P mg	Uptake of N mg	Uptake of K mg
1. Batu Hitam -	15.0	35.0	0.52	.026	1.21	15.0	39.8	1.41	.047	.20	19.8	746.5	508.3
1a „ „ F -	19.0	44.0	0.55	.024	1.38	18.0	43.0	1.38	.044	.20	29.5	842.8	698.6
2. Tok Yong -	16.6	34.6	0.40	.022	1.22	16.3	35.5	1.19	.096	.29	41.7	547.0	520.5
2a „ „ F -	21.3	43.8	0.40	.024	1.57	19.6	43.3	1.20	.085	.27	47.2	698.4	806.7
3. Lubok Itek -	12.0	29.5	1.31	.023	1.34	11.3	28.8	1.64	.052	.26	21.9	859.5	478.9
3a „ „ F -	13.6	33.1	1.32	.023	1.55	13.3	33.8	1.71	.051	.19	24.9	1015.2	577.7
4. Kg. Tipus -	16.3	41.5	0.44	.018	1.22	15.6	32.1	1.22	.060	.22	27.6	581.1	563.1
4a „ „ F -	15.0	39.3	0.44	.011	1.56	15.0	38.4	1.37	.053	.21	27.2	698.4	686.2
5. Pasir Puteh -	15.0	45.0	0.54	.034	0.77	16.6	12.2	1.42	.088	.25	25.7	420.0	379.4
5a „ „ F -	19.3	47.6	0.60	.024	1.10	18.3	17.8	1.44	.060	.21	22.4	539.0	575.4
6. Def. area -	11.0	24.8	0.55	.027	1.02	10.6	16.0	1.29	.076	.26	19.8	343.6	283.2
6a „ „ F -	16.6	37.5	0.52	.021	1.22	13.0	22.1	1.38	.055	.21	21.8	510.0	474.4
7. Byan Pyas -	28.3	64.3	0.53	.034	1.29	28.7	70.3	1.36	.108	.27	97.5	1297.2	1017.8
7a „ „ F -	32.7	76.0	0.58	.035	1.22	31.6	75.1	1.35	.086	.27	90.7	1448.0	1104.9
Standard Error -		±6.376	±.099	±.0070	±.174		±5.36	±.072	±.0121	±.0235	±5.57	±41.18	±51.81

Examination of the grain yield figures in Table I shows that very little increase in yield was obtained by adding all other elements except phosphate. It is clear from this that phosphate fertilisers are particularly necessary in the Kelantan soils. The Tok Yong series which occurs close to small streams and is not very extensive is slightly better than the rest but even this soil is still very deficient in phosphate.

Experiment No. 2

Since most Kelantan soils have been found to be deficient in phosphate it was decided to find out what type of phosphate fertiliser would be most beneficial. An experiment was therefore designed using the Batu Hitam soil series and three types of phosphate, that is, water soluble super phosphate, citric acid soluble fused magnesium phosphate and relatively insoluble rock phosphate. The phosphate fertilisers were analysed and the results were as follows:—

	% P_2O_5 in the various phosphates		
		* Citric acid	
	Water sol.	soluble	Total
1. Double Super Phosphate	40.0	40.0	40.0
2. Christmas Island Rock Phosphate	0.04	8.16	36.7
3. Fused Magnesium Phosphate	0.35	18.8	19.3

The pots used in the experiment consisted of plastic buckets of 1½ gallon capacity each filled with 10 lbs. of Batu Hitam soil. The treatments were as follows. There were 4 replicates.

Treatment	P. Fertiliser in gms/pot.	P_2O_5 in lbs. per acre
1. Control (no fertiliser)	—	—
2. NK but no P.	—	—
3. NK C.I.R.P. (1)	0.67	40
4. NK C.I.R.P.	1.35	80
5. NK Fused Mg Phosphate	1.26	40
6. NK Double Super Phosphate	0.60	40

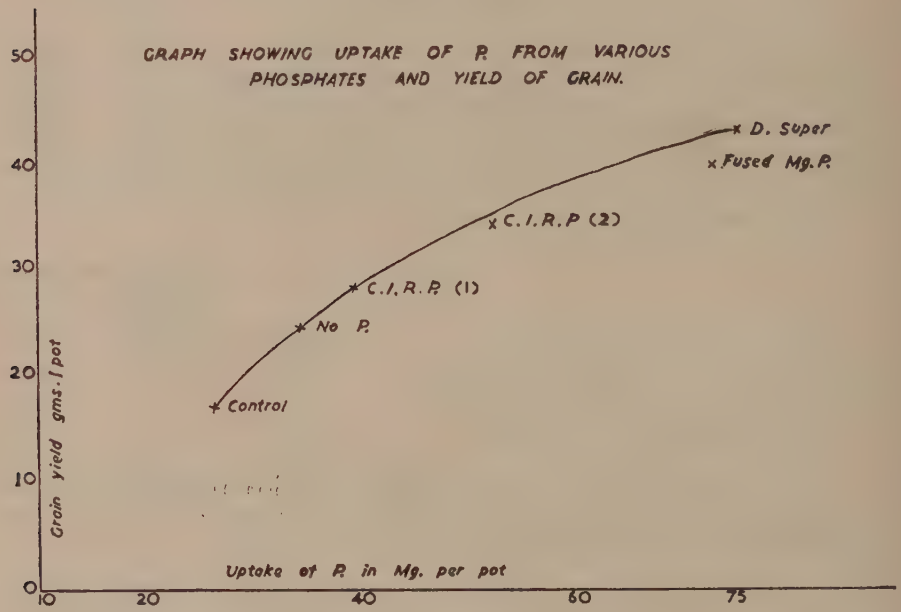
N—0.3 gms urea at transplanting and 0.3 gms after 5 weeks (= 1 cwt/acre).

K—0.3 gms Muriate of Potash (= 56 lbs per acre).

Two seedlings (variety Pebifun) 27 days old were planted in the middle of each pot, and the pots were arranged at random in the padi cage. Two tiller counts were made during the growth of the plants and the plants were harvested at maturity as was done in Experiment No. 1.

* The citric acid soluble phosphate was obtained by shaking 2.5 gms of fertiliser for half an hour with 250 ml of 2.0 per cent citric acid solution.

Analyses were made for yield of straw and grain and the percentage of nitrogen, phosphate and potash. (Table II). The uptake of phosphate by plants in the various treatments was calculated (Table III). The values are only approximate as the addition of phosphate usually results in a better root system which in turn enables more phosphate from the soil to be taken up. The increased yield of grain from increased uptake of phosphate is shown in the graph.



From Table II it is clear that Christmas Island Rock Phosphate was inferior to fused magnesium phosphate and double super phosphate under the conditions of the experiment. The percentage of applied fertiliser taken up was very high, in the case of citric acid soluble and water soluble phosphate, reaching almost 40 per cent—which might mean that there would be little residual effect from these fertilisers. The availability to the plant of citric acid soluble phosphate and water soluble phosphate seemed to be about the same.

Discussion

In the exepriment just reported the value of off-season vegetation was not considered since there is very little off-season growth in most padi areas of Kelantan. However, decaying organic matter can affect the solubility of rock phosphate in the soil and so a pot test using two Kelantan padi soils (Kampong Tipus series and Pasir Puteh series) was carried out to verify this. The test showed that an increase of more than 50 per cent was obtained in grain yield when rock phosphate and

Table II

Treatment	Tillers Days from transplanting			Straw gms/pot	Straw—Dry matter basis			Grain gms/pot	Gran—Dry matter basis		
	42	26	Harvest		% N	% P	% K		% N	% P	% K
1. Control	6.0	9.0	10.8	19.4	0.63	.030	1.66	17.4	1.42	.121	.210
2. NK	6.0	12.5	13.8	27.1	0.79	.629	1.37	24.8	1.58	.107	.207
3. NK + C.I.R.P. (1)	7.5	13.5	16.0	28.9	0.53	.026	1.20	28.1	1.44	.114	.209
4. „ + C.I.R.P. (2)	10.75	18.25	16.8	37.9	0.44	.026	1.05	34.8	1.32	.120	.208
5. „ + Mg P	18.75	23.75	23.0	38.9	.040	.032	0.83	39.8	1.18	.155	.221
6. „ + D. Super	16.25	22.5	21.0	41.8	0.42	.033	0.84	43.6	1.19	.142	.223
S.E.	—	—	—	±4.12	±.0546	±.0026	±.119	±3.01	±.076	±0127	±.0166

Table III

Treatment No.	Phosphate applied P_2O_5	Phosphate applied gms/pot	Uptake of P in mg	Uptake of P from fert.	% Uptake from fert.
1	—	—	26.38	—	—
2	—	—	34.33	—	—
3	40	0.67	39.65	5.32	5.04
4	80	1.35	52.53	18.20	8.64
5	40	1.26	73.18	38.85	36.9
6	40	0.60	75.10	41.37	39.3
S.E.			±5.040		

green matter were added together. A heavy dressing of nitrogen and potash had been given to all pots in the test including those without green matter, so that the increase in yield may be largely attributed to the effect of green matter on the rock phosphate.

Since rock phosphate is the cheapest source of phosporus in Malaya, it seems advisable that it should be used in conjunction with green manure. The decomposition of organic manure under water-logged conditions produces organic acids which help to make rock phosphate more available. In areas where off-season growth is poor and green matter is not available. then citric acid or water soluble phosphates would probably be superior to rock phosphate. In areas which are relatively more acid (as a result of sulphate), fused magnesium phosphate and sometimes rock phosphate would be preferable to double super phosphate. The present system in Kelantan of adding half of the phosphate as double super phosphate and half as rock phosphate has much to recommend it. It should be noted that in these experiments the short-term variety Pebifun (maturation period 110-120 days), was used. Long and medium-term Indica varieties may be slightly more efficient in making use of the comparatively less soluble rock phosphate.

Summary

Two experiments were conducted with Kelantan soils, one to determine the available phosphate and the other to find the type of phosphatic fertiliser most suited for these soils.

All the major padi soils of Kelantan contained very little available phosphate especially when compared with some of the padi soils from Kedah, as a result, very little increase in yield can be obtained by the application of all other mineral nutrients except phosphate.

Citric acid and water soluble phosphates are superior to the relatively insoluble rock phosphate on Kelantan soils especially in the absence of green matter.

Since rock phosphate is the cheapest form of phasphate, per unit phosphate content, it is suggested that it should be used with green matter, to supply the padi plant with phosphate.

Acknowledgements

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PRESENT STATUS OF RICE BREEDING IN MALAYA

BY

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Introduction

As early as 1915 H.W. Jack (1) started pure line selections of Seraup Kechil, Seraup Besar, Pahit and Radin Merah at Titi Serong. Later R. B. Jagoe (2) and B. A. Lowe (3) collaborated in this work and the work of varietal improvement was expanded in 1927 to include hybridization of various local varieties at Titi Serong. Except for hybrid vigour which was observed in the F_1 plants no further results were published and no new varieties were evolved from this line of work (4).

Pure line selections, however, were more successful and high yielding strains of Seraup and Radin were selected at Titi Serong and distributed, viz., S.K. 36, 52, Radin 2 and 7. (Seraup Kechil 48 was later distributed and practically replaced S.K. 36 in Krian in 1936).

In Kedah, at Telok Chengai, strains of Mayang Ebos, Radin China and Serendah Sungei Dua were selected whilst in Malacca at Pulau Gadong selections included such well known strains as Nachin 11 and Siam 29.

There was a complete cessation of padi varietal work in Malaya during the Japanese occupation and most of the pure lines previously selected were lost. Those that survived because of their extreme popularity, e.g. S.K. 48, Sm. 29 and Nachin 11 became admixtures. It was necessary therefore to start the postwar work on varietal improvement from the beginning. The programme of improvement (5) was based on the following:—

(a) Comparative yield trials of local and redistributed varieties of primary importance.
(b) Improvement of the best local varieties by pure line selection.
(c) Study of local varieties of secondary importance and exotic varieties, with a view to their commercial exploitation or use in hybridization.
(d) Selection within Hybrid populations.
(e) Study of Variety/Fertiliser Interaction.
(f) Quality assessment, relative to selection and distribution of improved strains, and
(g) Ancillary investigations.

When work on padi was recommenced in 1946 and during the next few years the order of importance assigned to these broad aspects

of work was that in which they are set out above particularly (a)—(e). In the natural course of events over the years as each aspect of the work has been satisfied, there has been a continuous shift in the relative importance of these undertakings. At present, fertilizer/variety interaction is considered to be very important.

Comparative Field Trials of Local and Redistributed Varieties of Primary Importance

This aspect of the work was most essential immediately after the war in order to select one or two best varieties for each particular ecological area. In the beginning, these trials were mainly confined to the local varieties which were dominant in each area but as they proceeded other less popular varieties were included for testing. At first very large numbers had to be tested, but these were gradually reduced, as can be seen from the following table:—

Period		No. of Varieties Tested
1947 — 1950 (ref. No. 6)	....	143
1950 — 1954 (ref. No. 7)	....	93
1954 — 1958 (ref. No. 8)	....	69

The first 3 to 4 years of this work were most important (1947-51) and as a result it was possible to recommend suitable varieties for many different areas.

Improvement of the best Local Varieties by Pure Line Selection

Even before the completion of the first series of comparative yield trials of local varieties (1947-1950) it was already apparent that certain varieties which were popularly and very widely grown could be improved by pure line selection. Five projects were therefore started, Radin Ebos Selection (1948), Mayang Sabatil Selection (1947), Nachin Selection (1947), Siam Selection and Seraup Selection (1949). However, it was mainly on the result of the first series of comparative trials that the majority of the pure line selection projects were recommended (6) and undertaken. These pure line selection projects included Seri Raja (1952) Machang (1953), Serendah Puteh (1953), Kontor (1952), Serendah Kuning (1950), Mayang Sagumpal (1951), Acheh Putch (1950), Anak Naga (1951) and Radin Kling (1954).

Period		No. of Varieties Tested	No. of Strains Tested
1947 — 50	....	143	0
1950 — 54	....	93	163
1954 — 58	....	69	295

After 1950, trials of selected strains began to replace straight forward trials of unselected local varieties and by 1956 pure strains

of Serendah Kuning 3, 11, 23 were released for general cultivation in Negri Sembilan and Nachin 57 in the Malacca Coastal area. These strains were fully tested in "extension trials" in farmers fields before they were released and they were capable of giving an average increase in yield over the local unselected material by 15-18%. Subsequently, new strains have been found for the other areas and as more widely adaptable selections have been developed they are being used to replace earlier strains with a more limited field of use. For example, in Negri Sembilan, Serendah Kuning 60 is now recommended to replace Serendah Kuning 3, 11, 23 wherever they were previously planted.

In Malacca, Nachin 57 has now been replaced by the higher yielding Nachin 39. In the deep areas of Krian, South Province Wellesley and Sungei Manik, the new selection Seraup 50 has replaced the pre-war selection Seraup Kechil 48.

Study of Local Varieties of Secondary Importance and Exotic Varieties with a View to their Commercial Exploitation or use in Hybridization

Padi improvement immediately after the war was mainly concerned with the study of indigenous varieties of primary importance. By the end of 1954 it was reported (5) that "most of the major indigenous varieties have been tested in the ecological areas to which they are likely to be adapted and work on pure line selection in a number of the major varieties is well advanced."

When most of the major varieties had been tested, more and more local varieties of secondary importance and introduced varieties were studied with a view to their use in hybridization and/or "commercial" exploitation. This has resulted in the identification of varieties with economically useful characteristics. For example, the local variety Arong was found to be salt tolerant; Haji Haroun and Radin Kling were found to have a low sensitivity to photoperiod. Because of these useful characters Arong and Radin Kling have now been used in hybridization with other useful major varieties.

The study of introduced varieties have also given useful results. Cadung Ket, a Saigon variety, has proved to be the most successful variety on sandy soils on the east coast typified by the Bachok Padi Test Station and is recommended for regional extension trials.

Another introduced variety, Engkatek from Sarawak, has proved quite adaptable in Malaya. This variety is found to have very strong short straw and high tillering capacity. Yields have been reasonably good and the variety has been distributed on a limited scale in Kedah. It has also been used quite extensively in the hybridization with local varieties on account of its short height which is ideal for mechanical cultivation and harvesting.

Selection within Hybrid Populations

The seed improvement methods described above will give quick results from material that is heterogeneous and untested but eventually they reach a point where very little further progress can be made. At this stage further progress can be achieved by hybridization. In anticipation of this the hybridization of *japonica* varieties with some local varieties and also between different local varieties was begun in the 1950/51 season, the former at Cuttack Rice Research Institute under the auspices of the International Rice Commission and the latter at Kuala Lumpur).

Subsequently, other crosses were also made at both these centres and the present material now carried at various stations in Malaya is at varying stages of selection. The most advanced generations have now reached F_{10} and the most promising lines are now undergoing comparative yield trials against local standard varieties. Preliminary results have been especially promising from the progenies of crosses between local varieties, and prospects of achieving new high yielding strains are good.

Study of Variety/Fertiliser Interaction

It has generally been held that the *japonica* group is, by its genetic constitution, more capable of responding to heavy fertiliser applications than the *indica group* of rices.

The International Rice Hybridization Scheme was set up in 1950 by the International Rice Commission, Food & Agriculture Organization, United Nations so that the hybridization of the best *japonica* varieties with the best indica varieties could be done on an international basis in order to attain quicker and better results. The main aim was to combine the *high fertiliser response* and low photosensitivity of the *japonicas* with the high tillering capacity and quality of the *indicas*.

Closely following the set up of the International Rice Hybridization Scheme, the Working Parties on Rice Breeding and on Fertiliser jointly approved in 1951 the co-ordinated investigation of variety manuring interaction, and an active search for *indica* varieties that give a marked fertiliser response was undertaken.

In 1957, at the 7th meeting of the Working Party on Rice Breeding and the 6th meeting of the Working Party on Fertiliser Practices, it was reported that fertiliser response had been detected in some *indica* varieties and this has since been confirmed in several other countries(9).

Moreover, the use of *japonica* varieties as a source of this characteristic was found to be troublesome for three main reasons. The hybrids showed a tendency to be sterile; they continued to show segregation even up to the F_8 generation and the *indica* grain type was very largely lost.

As a result, the Working Party on Rice Production and Protection recommended at its meeting in 1959 that:—

"Countries which maintain genetic stock of *indicas* would be

well advised to grow these stocks under both high and low levels of fertility in order to find varieties which are capable of giving high fertiliser responses".

Since it was already known that some Malayan varieties could yield over 2½ tons per acre under fertile conditions it was reasonable to assume that they could respond to fertiliser. The present selection and breeding programme therefore includes:—

(a) Testing all prominent local varieties under various levels of fertilisation with a view to finding varieties which show fertiliser response. (This is particularly important for the synthesis of new strains with a high fertiliser resonse).
(b) The selection of new strains from hybrid populations carried out under a high level of fertility.
(c) The testing of new strains under varying levels of fertility.

Quality Assessment Relative to Selection and Distribution of Improved Strains

This aspect of the work on the improvement of rice in Malaya has not been studied to a great extent, but would need greater emphasis in the future when new hybrid varieties are distributed and specific standards have been introduced to classify the rice in this country. The present investigations are mainly confined to climination of varieties the grains of which show excessive chalkiness, poor '*japonica*' quality and red paricarp.

Ancillary Investigations

Other lines of investigation, which are pursued less vigorously and only when the staffing situation permits, include the systematic classification of Malayan varieties, the enumeration of basic characteristics such as leaf indices and optimum photoperiod and the development of new strains through the use of X-ray and chemical treatments.

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PSOROSIS VIRUS A ON CITRUS NOBILIS LOUR. (MANDARIN ORANGE) IN MALAYA

BY

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Introduction

Psorosis, a virus disease of citrus, has been responsible for the destruction of many varieties of citrus in almost all citrus growing areas of the world. Symptoms appear on young leaves as faint flecks which may coalesce to form oak leaf patterns. In addition scaly bark symptoms may be observed on a number of varieties of citrus. Sweet orange and tangerine have been reported to suffer most from bark scaling.

This disease has hitherto not been reported from Malaya. Recent investigations on the possible presence of virus diseases on citrus have shown a large number of mandarin orange trees in Segamat to be affected by die-back of the shoots (Fig. 1) and severe scaling of the bark (Fig. 2). No leaf symptoms however have been observed on affected trees. The disease was present in almost all the mandarin orange orchards visited and appeared to be fairly widespread. Typical leaf symptoms were observed on inoculated lime indicator plants.

It is possible that the disease has been established in Malaya for quite some time, but has not been detected until now. The disease was probably introduced into Malaya on citrus plants imported from countries where Psorosis was present. The common practice of propagation by marcots has contributed largely to the spread of the disease.

Materials and Methods

Budwood materials were collected from two eight-year-old mandarin orange trees affected by bark scaling. Inoculations were made on to Key lime indicator plants by patch bark grafting (Wallace, 1945). Key lime plants with a basal trunk diameter of approximately 5 to 8 mm. were used. One horizontal and two vertical cuts were made on the basal portion of the trunk and the bark stripped downward. Grafts were made whenever possible just below and in line with an attacked leaf. Rectangular pieces of bark slightly smaller than the area under the bark flap were taken from a branch of the diseased tree. Areas from where the inoculations patches were taken were scraped to remove the cuticle and epidermal cells. The bark flap was then folded back in position over the inserted bark patch, with the cambium of the bark patch placed adjacent to that of the Key lime plant.

A strip of adhesive rubber tape was applied over the completed bark graft. The inoculated plants were topped off to a few inches above

the bark patch. Bark patch inoculations were made on 12 Key lime indicator plants and 12 uninoculated plants were maintained as controls.

Results

Leaf symptoms were observed on the inoculated plants 19 days after inoculations. Flecking and stippling of young leaves (Fig. 3) were observed on 9 of the 12 inoculated plants. Plants which showed symptoms were slightly retarted in growth compared to the controls (Fig. 4). Some of the affected leaves were also found to curve downwards. More severe symptoms, 'shock symptoms', were observed on 3 of the 9 infected plants. Young shoots were slightly twisted and eventually becomes bowed. The leaves were found to drop off with the least disturbance. Growing points frequently wither and drop. No symptoms developed on any of the 12 uninoculated plants maintained as controls (Table I).

Table I

Treatment	No. of plants grafted	No. of plants showing symptoms
Inoculated	12	9
Uninoculated	12	0

Discussion

This is the first record of a virus disease on citrus in Malaya. At the moment only mandarin oranges have been proved experimentally to be affected by Psorosis Virus A. There is an indication that the disease is also present in the citrus growing areas of Teluk Anson. Investigations are being continued to test the presence of Psorosis and other viruses on citrus varieties in Maalya. It is hoped that a suitable certification scheme may be set up to ensure that only healthy materials are being distributed to farmers.

Acknowledgement

The assistance rendered by Mr. W. A. Sankey throughout the investigation is gratefully acknowledged.

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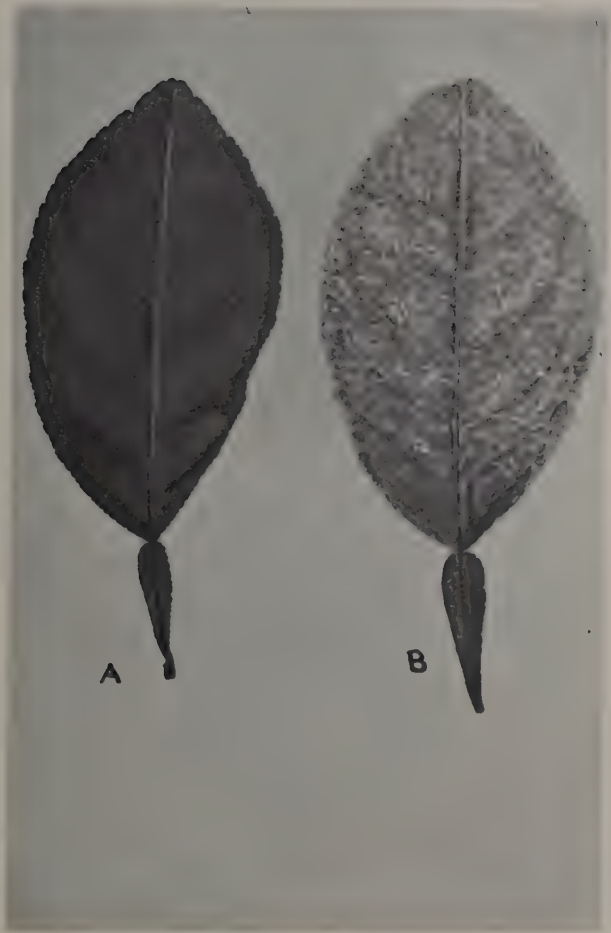
FIG. 1

Eight-year-old mandarin orange tree affected by psorosis virus A. Note poor growth of tree and die-back of the shoots.

FIG. 2

Photograph of a branch of the tree in Fig. 1 showing scaling of the bark caused by psorosis virus A.

FIG. 3



(A) Symptomless leaf from uninoculated Key lime.
(B) Young leaf of Key lime showing flicking.

FIG. 4 A

Key lime seedling showing symptoms of psorosis virus following bark-patch grafting. Shoots are retarded in growth and slight bowed. Note curling of leaves on extreme left shoot.

FIG. 4 B

Healthy corilist Key lime sudling.

CURRENT NOTES

July to December, 1960.

Weather

Weather conditions during the period has been normal and rainfall adequate to allow cultivation and transplanting of padi to be carried out according to schedule.

Padi

Crop Report

Off-Season Padi

The 1960 off-season padi crop surpassed all previous years' records in planted and harvested acreage. The total area in 1960 was 20,878 acres as compared with 11,640 in 1959—an increase of 9,238 acres, principally in the States of Province Wellesley and Kelantan which registered an increase of 7,402 acres and 1,263 acres respectively.

In those States in which double-cropping was carried out yields have been very good. In the Tumpat District, Kelantan, the average yield was 543 gantangs per acre and the average yield for the whole of Province Wellesley was 445 gantangs per acre.

Wet Padi

Transplanting of wet padi in all States was completed during the period. The acreage planted was 877,755 acres as compared to 868,895 acres for 1959/60 season, giving an increase of 8,860 acres.

Harvesting commenced towards the end of the year in the States of Kedah and Perlis. In Perlis the early varieties gave an average of 340 gantangs per acre and the medium term varieties of which 6,860 acres have so far been harvested gave 372 gantangs per acre. In Kedah 57,036 acres of early and medium varieties have so far been harvested, giving an excellent average of 525 gantangs per acre. Some farmers were known to have obtained yields of 900 gantangs per acre.

The prospects for the current season's crop are, therefore, excellent and it is likely to surpass all previous years' average yields, the contributory causes being increased use of fertilisers, use of better seed and better all-round husbandry together with good weather.

Research and Selection

Padi Nutrition

Results obtained from pot experiments of major padi soils from Kelantan have been statistically analysed. The yield of grains in grams per pot was as follows:—

Yield of Grain in gms. per Pot

No.	Soil Series	Control No. Fertiliser	N only	P only	NP	NPK, Lime + Trace Elements	SE
1.	Batu Hitam -	17.66	22.5	21.5	28.5	34.2	0.94
2.	Tok Yong -	15.5	30.0	18.0	34.3	34.7	1.37
3.	Lubok Itek -	14.3	19.0	17.2	28.3	34.3	1.38
4.	Kampong Tipus -	13.2	15.5	15.5	30.5	32.5	1.69
5.	Pasir Puteh -	13.2	14.8	14.2	26.1	32.0	1.74

It is clear from the results that the yield of padi could be raised considerably by the addition of nitrogen and phosphate together. Only in the case of the Tok Yong river terrace soil is there fairly adequate phosphate.

It is often considered generally that potash and other elements are not very important but the results seem to indicate that potash and/or other elements gave significantly increased yields in the soils examined with the exceptions of Kampong Tipus series and the Tok Yong series which seem to be supplied with adequate potash and other elements except nitrogen.

Pot experiments with some of the major soils of Kedah/Perlis area were also concluded.

Yield of Grains in Gms. per Pot

No.	Soil Type	Control No. Fertiliser	N only	P only	NP	NPK, Mg., Lime + Trace Elements
1.	Tanjong Karang -	84.1	—	—	—	76.6
2.	Kuala Muda -	38.5	57.0	41.4	52.3	50.6
3.	Telok Chengai -	19.9	27.0	22.5	35.6	29.6
4.	Tualang Idris -	23.8	31.4	23.2	36.2	28.0
5.	Kangkong Sedaka -	20.6	21.6	25.0	35.0	30.8
6.	Kuala Perlis -	18.8	28.2	21.6	30.0	38.7
7.	Kangar -	17.9	27.9	19.1	28.6	33.4
8.	Pengkalan Kondor -	34.0	37.0	29.9	41.3	41.0
9.	Yen -	10.0	10.8	10.9	12.6	36.4

Unlike most of the Kelantan soils, the Kedah/Perlis soils do not react to fertiliser in the same way. The further addition of potash, lime and trace elements has had little beneficial effect on yield and it is

doubtful, therefore, whether much potash and trace elements are required in a large proportion of the Kedah/Perlis soils.

On Kedah/Perlis soils nitrogen is the most important and phosphate seldom gives increased yields except in combination with nitrogen. Lime is of little value except on the Yen and Kuala Perlis series.

The results also show that the Tanjong Karang soil, Selangor (from the Soils/Water Research Station), gives easily the highest yield of any soil tested and that the addition of fertiliser has depressed yield and not increased it. The yield of 84.1 gm. per hill is equivalent to 8,076 lbs. or 1,442 gantangs of padi per acre.

Comparing the Tanjong Karang soil with the Kedah/Perlis soil, it seems that if higher yields are to be achieved in the Kedah/Perlis area the need will be not only for appropriate manuring but also for improving soil conditions by more thorough cultivation.

Soils/Water Research

A water/requirement (transpiration ratio) experiment carried out by Dr. S. Matsushima, F.A.O. expert has been completed. As a result the amount of water transpired by the rice plant under Malayan conditions has been determined for the first time. The seasonal variation in the transpiration rate has also been measured. The transpiration ratio obtained was 446, i.e. the amount of water necessary to produce one gram of dry matter is 446 c.c. From this figure the amount of water transpired by the rice crop in any padi field can be determined. Thus for a field yielding 500 gantangs of padi per acre the volume of water transpired would be 263,358 gallons per acre or approximately 55,000 gallons per 100 gantangs.

The value of 446 is surprisingly low for a tropical country, but refers to a short term variety. The corresponding ratio for padi grown during the main season is in the process of being determined.

Breeding and Selection

The programme for 1960/61 represents a major swing towards the development of new hybrid strains with a greater range of adaptability and response to fertiliser. A number of trials have been established throughout the Federation. These have shown a general response by all varieties, but unfortunately the more lush growth at the highest fertiliser level has often been associated with increased rat damage and lodging.

The results of off-season trials were generally disappointing due to bird and rat damage. It was found that a high proportion of the *indica* x *indica* hybrid lines were too sensitive to the long days and were unable to flower satisfactorily.

The *indica* x *japonica* hybrids (Cuttack hybrids) are still showing segregation in the F_8 and F_9 generations, but a few non-photosensitive lines have been found to have long grains and these may prove very valuable.

AGRONOMIC INVESTIGATIONS AND EXTENSION

Padi Mechanisation

The off-season crop of Kenaf grown at the Padi Mechanisation Scheme, Parit, has been harvested. This crop has proved easy to establish and requires little attention. An average yield of 4.64 piculs * of dried fibre per acre was obtained. Samples of the fibre are being tested for quality.

In the States, particularly in Trengganu and Kelantan, the use of pedestrian tractors for the preparation of padi fields is gaining popularity. The cost of running a Kubota tractor at Bachok was about $4.00 per hour and the charge per acre was from $16—$20. This figure compares very favourably with cattle cultivation.

In Perlis mechanical threshing of padi with the Marsden thresher was demonstrated and resulted in enquiries from farmers for the purchase of these types of portable threshers.

In Province Wellesley mechanical cultivation of padi is gaining popularity. The number of tractors in operation was reported to be 46, viz. 44 four-wheeled tractors and 2 Kubota tractors. Most of the tractors are owned by contractors.

Fertiliser Trials

Efforts are being concentrated to find suitable type of fertiliser and mixtures for the various soil types. A variety x times of application of NPK ratios x type of Nitrogen experiment and a variety x fertiliser experiment have been laid down on three soil types in Kedah viz:—

(a) Telok Chengai Padi Experiment Station—Telok Chengai soil series.
(b) Sungei Limau-farmers' land—Pengkalan Kundor soil series.
(c) Guar Chempedak—farmers' land—Yen soil series.

Preliminary growth observations at Telok Chengai appear to show marked responses to N.P. & K. Growth responses to sulphate of ammonia and urea appear to be of the same order under these conditions.

Examination of the Yen Soil Series around Guar Chempedak shows that this soil has a low pH (pH_4) with poor drainage. Quick soil tests showed a high content of reduced iron, low available P & K and poor base status. Liming appears beneficial and there appears to be marked response to N.P. & K. Under these conditions urea appears to be a better nitrogenous fertiliser than sulphate of ammonia.

* 1 picul = 133⅓ lb.

Results from the Double-Cropping Experiment for the 1960 off-season crop show that:—

(i) There were definite responses to single dressing of N.P.K. (30 : 30 : 15) and to double dressing N.P.K. (60 : 60 : 45) supplied during the main season done. The double dressing, however, was only slightly better than the single dressing,

(ii) The responses to single and double N.P.K. dressings applied during the off-season alone were better than the corresponding main season applications.

(iii) The responses to the single and double-dressing N.P.K. applied both in the main season and off-season were about the same as those applied in the off-season alone.

Rubber

In the third quarter, distribution of rubber planting material to smallholders amounted to 1,289,000 clonal seedling stumps and 156,180 yards of budwood and in the last quarter the distribution of clonal seedling stumps has increased to 2,478,681. The distribution of budwood, however, was steady at 152,877 yards.

As a result of the heavy demand for clonal seedling stumps during the third and last quarter of the year, a definite shortage was felt and as an emergency measure, Kelantan distributed direct from the germination beds 231,850 germinated seeds.

Coconuts

50 acres of new planting and 37 acres of replantings under the Rubber Industries (Replanting) Board Scheme were carried out in Perak during the third quarter of 1960. On the other hand 105 acres in Penang and Province Wellesley were replaced by rubber and 4 acres by fruit.

During the last quarter of the year, new planting and replanting with coconuts were carried out in Perak (150 acres), Selangor (24 acres) and Johore (198 acres).

In Kelantan the growing of stylo (Stylosanthes gracilis) with coconuts at Bachok demonstrated that the palms showed better growth.

The Rhinoceros beetle (Oryctes rhinoceros) continued to be a major pest of the crop. The result of an experiment on the insecticidal control of this pest indicates that the possibilities of insecticidal control do not appear to be promising. Biological control of Oryctes is being investigated and the parasite Platymerus rhadamanthus, claimed to give a degree of biological control in Zanzibar, has been imported to Malaya for investigational purposes. Work is in progress on the observation of the life cycle.

In the States, the selection of mother palms with a view to supplying good seed nuts for replanting and new planting of coconut holdings has commenced.

Coffee

The price of coffee beans continued to decline during the second half of the year (from $110 per picul to $87 per picul). Inspite of this 29 acres were planted under the replanting scheme in Selangor during the last quarter of the year.

Fruit

Fruit of many types has been in season during the third quarter in most States. Particularly heavy crops of rambutans, durians, mangosteens and langsat were obtained in Kelantan and Trengganu.

As a result of favourable weather during the fourth quarter 1,500 acres of rubber newplanting and replanting were underplanted with bananas.

As a result of the heavy incidence of foot rot disease in citrus, suitable rootstock which are resistant to this disease are being sought for a trial to be laid down at Telok Bharu Federal Experiment Station. Material for this trial has been prepared.

An experiment was started to investigate the keeping qualities of high quality durians under deep freeze conditions. It has been found that peeled durians keep fairly well when sealed in polythene and stored at —8°F.

In another experiment on the canning of rambutans, little difference was found of the syrup sugars between the one made with Taikoo sugar and that made with cheaper granulated sugar.

Steady interest was shown in the replanting and rehabilitation of neglected pineapple holdings during the second half of the year. 324 acres in Selangor and 130 acres in Johore were planted under the Rubber Industries (Replanting) Board assistance.

Harvesting of smallholdings in Johore and Selangor continued during the fourth quarter; 1,205 tons of fruit were delivered to the canneries in Johore and 826 tons to the cannery in Selangor. (The cannery in Selangor harvested 1,297 tons from its own estate).

Sales of fertilisers for pineapples in Johore in the fourth quarter were high; the Pekan Nanas Co-operative Society distributed 400 tons.

Tobacco

Interest in this crop was well maintained during the third and fourth quarter of 1960, and was mainly confined to the State of Perak.

In the third quarter 1,360 acres were under cultivation in the State and in the fourth quarter 1,500 acres. Prices paid for dried leaves varied considerably between localities but on the whole were steady, No. 1 Grade fetching between $130—$200 per picul.

Analysis of 21 samples of tobacco leaves from a manurial trial from Kelantan was carried out. It was found that the nitrogen was lower and the potash higher than tobacco imported by the Malayan Tobacco Company who has shown keen interests in tobacco planting during the padi off-season in Kelantan.

Pastures and Fodders

Efforts to encourage padi planters to establish fodder crop plots to overcome the acute fodder shortage problem has met with very good success particularly in Kelantan, Pahang and Trengganu. A slow but steady increase in the use of stylo as a cover in smallholders' young rubber is reported in the Machang area of Kelantan where two replanted smallholdings are providing an excellent demonstration of the ability of stylo to swamp natural grasses and weeds under very adverse soil and management conditions.

At Melor in Kelantan, a second crop of dry padi on a plot previously grown with stylo indicated that the fertility of the soil was greatly improved.

Vegetables

Investigations are being continued at Cameron Highlands to replace prawn dust in order to lessen the liability of the health of the community from flies which are attracted to this type of manure used in the cultivation of vegetables in this area.

It has been observed that flies breed in Sterameal in certain cases.

The results of the fungicidal trial on Potato Late Blight incorporating dithiocarbamate fungicides have been analysed. It was found that all treatments were significantly better than the control and Tritoftorol once again gave the best results.

Total Yield of Healthy Potato Tubers (in pounds from six plots)

	June 1959	1959/60	May 1960
Control	3.75	33.25	12.08
Bordeaux Mixture	38.75	83.00	39.04
Tricarbamix Special	84.50	133.50	44.54
Trimangol	34.25	98.50	28.08
Tritoforol	73.00	125.25	55.50

Soil Survey

An important change was made in the work being followed by the soil survey unit and work on the Schematic Reconnaissance soil survey

programme which was being conducted in the State of Perak was temporarily suspended. First priority is now given to the examination of areas proposed for agricultural development under the Government's Rural Development Programme.

Owing to the onset of the North East Monsoon and the resulting field inactivity during the fourth quarter of the year, an opportunity was taken to concentrate on map compilation and report writing covering previously completed systematic surveys. As a result the schematic-reconnaissance soil map of Kelantan was completed and passed to the Geological Survey for astrafoil drafting.

Field work on the Johore Coconut Soil Survey has commenced over the coastal areas between Muar and Batu Pahat and around the South Batu Pahat estuary and in the South Senggarang area. Preliminary results indicate that the areas of peat are even more widespread than has previously been estimated and that the acreage of rich soils is limited to a very narrow band fringing the coast.

STAFF NOTES

(Period 1st July to 31st December, 1960)

Appointments

		w.e.f.
Dr. Ng Siew Kee	Soil Scientist	3. 8.60
J. Kawakami .... (Colombo Plan)	Botanist (Plant Breeder)	1.12.60

Promotions

A. R. McWalter .... Senior Research Officer, Grade A.	Assistant Director (Research)	4. 8.60
W. P. Panton .... Soil Scientist, Timescale	Senior Research Officer, Grade A	4. 8.60

Postings and Transfers

Mohd. Ridzuan bin .... Mohd. Nor Agricultural Officer	State Agricultural Officer, Malacca	29. 8.60
Mohd. Noor bin Wahab State Agricultural Officer, Malacca.	State Agricultural Officer, Kedah (Acting Senior Agricultural Officer, Grade A).	1. 9.60
G. I. M. Martin .... Ag. State Agricultural Officer, Kedah.	Principal, College of Agriculture, Serdang (Acting).	1. 9.60
Van Thean Kee .... Botanist.	Senior Agricultural Officer (Headquarters). (Acting Senior Agricultural Officer, Grade B)	1. 9.60
Abdullah bin Omar	Higher Executive Officer, ... Headquarters.	1. 9.60
Chew Hong Jung .... Principal, College of Agriculture.	Assistant Director (Field) .... (Acting).	13. 9.60
	Deputy Director (Acting)	14.11.60—28.12.60
Mohamad bin Jamil .... Ag. Deputy Director of Agriculture.	Director of Agriculture (Acting).	14.11.60—28.12.60

Leave

J. S. Ure .... Ag. Director of Agriculture.	Annual Leave	14.11.60—28.12.60

G. W. Arnott, Senior Chemist.	....	Returned from long leave	....	3.11.60
Ahmad bin Yunus Entomologist.	....	Returned from study leave	....	1.11.60
Ting Wen Poh Plant Pathologist	....	Returned from study leave	....	17.12.60

Retirements

The following officers proceeded on leave prior to retirement under the Tenth Schedule to the Federation of Malaya Agreement (Amendment Ordinance No. 4) Ordinance, 1956.

F. G. N. Conaty	....	Assistant Director (Research)	....	3. 8.60
C. Whitehead Senior Agricultural Officer, Grade A.	....	Assistant Director (Field) (Acting).	....	11. 9.60

The following officer relinquished duties on completion of contract in Malaya.

K. Fuji (Colombo Plan)		Botanist (Plant Breeder)	....	31.12.60

STATISTICS

July to December, 1960.

Table 1

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, JULY TO DECEMBER, 1960.

(dollars per pikul*)

1960	Alor Star, Kedah			Seremban, Negri Sembilan			Johore Bahru, Johore		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Smoked Sheet									
No. 1	114.13	107.38	108.56	115.37	108.48	109.97	112.49	105.98	108.75
No. 3	110.68	104.38	103.74	112.52	106.41	105.15	110.26	104.19	104.47
1960	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Smoked Sheet									
No. 1	102.95	95.31	95.10	103.60	96.09	95.04	102.18	95.00	95.05
No. 3	97.86	92.28	90.99	99.65	92.86	91.02	9.16	92.76	91.79

* 1 pikul = 133⅓ lb.

This table has been compiled from Statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1959	1960	1959	1960	1959	1960
January -	37,600	37,400	27,200	27,400	64,800	64,800
February -	27,900	31,800	21,200	22,500	49,100	54,300
March -	28,500	29,900	21,100	24,800	49,600	54,700
April -	28,800	28,000	19,300	19,000	48,100	47,000
May -	33,500	33,000	22,300	24,000	55,800	57,000
June -	33,800	34,000	24,200	24,000	58,000	58,000
July -	35,600	37,000	26,700	25,900	62,300	62,900
August -	36,400	36,100	24,700	25,900	61,100	62,000
September -	35,600	36,600	25,900	25,000	61,500	61,600
October -	35,900	37,000	25,300	25,900	61,200	62,900
November -	35,600	35,200	23,900	21,500	59,500	56,700
December -	38,500	39,100	26,600	27,500	65,000	66,600
Total -	407,700	415,100	288,400	293,400	696,100	708,500
Total 1958 -	390,200		271,500		661,300	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan	Ceylon	Indonesian	India		African
				Northern	Southern	
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1. 7.60	3 5.17	4 5.46	Nil	4 6.01	3 7.30	3 3.24
8. 7.60	4 2.49	4 5.98	Nil	4 4.85	3 5.49	3 4.76
15. 7.60	4 2.23	4 6.99	3 0.50	4 5.87	3 4.42	3 6.70
22. 7.60	3 7.62	4 6.65	Nil	4 6.43	3 4.33	3 4.92
29. 7.60	3 6.43	4 7.54	Nil	5 2.19	3 5.39	3 3.73
12. 8.60	3 5.55	4 10.71	Nil	6 10.89	3 6.67	3 3.26
19. 8.60	3 10.30	5 3.01	2 11.33	7 7.09	3 8.37	3 5.08
26. 8.60	4 0.45	5 8.12	Nil	6 5.86	3 9.97	3 6.15
2. 9.60	4 1.28	6 0.72	Nil	6 5.47	3 10.67	3 6.57
9. 9.60	4 5.86	6 4.68	3 2.54	6 10.05	3 9.92	3 7.64
16. 9.60	3 10.20	6 8.21	Nil	7 10.51	3 10.19	3 7.80
23. 9.60	4 6.05	6 10.80	Nil	7 3.19	3 11.70	3 7.65
30. 9.60	4 6.85	6 4.91	Nil	6 2.17	4 0.41	3 10.54
7.10.60	4 6.94	5 11.31	Nil	5 11.54	3 11.93	3 10.76
14.10.60	5 2.90	5 11.32	Nil	5 8.26	4 1.13	3 8.86
21.10.60	5 2.48	6 0.96	3 5.50	5 9.49	4 1.81	3 4.31
28.10.60	5 4.66	6 4.82	Nil	5 10.14	4 3.64	3 3.66
4.11.60	Nil	6 8.69	Nil	6 1.08	4 6.91	3 3.55
11.11.60	Nil	6 2.94	Nil	5 10.19	4 7.06	3 2.96
18.11.60	4 2.49	5 7.43	Nil	5 6.01	4 4.52	4 2.16
25.11.60	Nil	5 4.42	Nil	5 4.24	4 4.92	3 11.82
2.12.60	4 6.54	5 3.44	3 6.85	5 2.22	4 5.58	3 11.91
9.12.60	4 3.11	5 3.28	3 5.75	5 1.99	4 6.52	4 0.78
16.12.60	4 2.41	4 3.32	Nil	5 1.97	4 6.23	4 1.05
23.12.60	4 11.03	5 1.79	Nil	5 0.58	4 7.15	3 11.69

* This table has been compiled from "Tea Market Reports" published by the Tea Brokers' Association of London.

Table IV
AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*
(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
2. 7.60	120.00	120.00
9. 7.60	120.00	120.00
16. 7.60	120.00	120.00
23. 7.60	120.00	120.00
30. 7.60	120.00	117.00
6. 8.60	120.00	117.00
13. 8.60	115.00	110.00
20. 8.60	120.00	115.00
27. 8.60	120.00	115.00
3. 9.60	120.00	115.00
10. 9.60	120.00	117.00
17. 9.60	120.00	118.00
24. 9.60	120.00	118.00
1.10.60	116.00	115.00
8.10.60	113.00	110.00
15.10.60	110.00	110.00
22.10.60	105.00	105.00
29.10.60	95.00	98.00
5.11.60	90.00	94.00
12.11.60	90.00	90.00
19.11.60	90.00	88.00
26.11.60	85.00	70.00
3.12.60	85.00	80.00
10.12.60	85.00	80.00
17.12.60	90.00	87.00
24.12.60	90.00	88.00
31.12.60	85.00	85.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.
† 1 pikul = 133⅓ lb.

Table V
PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL
(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil *		
	1959	1960	1959	1960	1960		
					£	s.	d.
January -	5,225	5,931	1,388	1,645	74	10	9
February -	4,824	7,232	1,356	2,012	75	10	3
March -	6,553	7,445	1,815	2,082	75	0	0
April -	5,268	7,638	1,404	2,030	74	11	2
May -	5,055	7,183	1,314	1,841	73	7	0
June -	5,931	9,127	1,565	2,352	71	4	2
July -	6,912	9,627	1,888	2,093	69	9	11
August -	7,005	8,007	1,958	2,101	69	10	0
September -	6,674	7,179	1,754	1,873	69	15	0
October -	5,031	6,827	1,536	1,782	72	1	0
November -	6,143	7,607	1,682	2,064	70	19	5
December -	6,018	6,540	1,634	1,797	70	6	0
Total -	71,541	90,343	19,294	23,672			

* F.O.B.

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE
FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960
January	1,827	2,299	8,000	7,700	9,827	9,999	4,195	5,233	2,709	3,227
February	1,947	2,323	1,500	8,000	3,447	10,323	3,556	5,919	2,298	3,670
March	2,377	2,575	6,000	11,000	8,337	13,575	4,027	5,091	2,643	3,132
April	2,523	2,554	6,000	9,800	8,523	12,354	4,636	5,503	3,041	3,472
May	3,097	2,821	8,000	11,000	11,097	13,821	5,327	6,203	3,519	3,888
June	3,338	2,779	13,000	12,800	16,338	15,579	8,385	7,015	5,499	4,410
July	3,779	3,382	9,000	15,054	12,779	18,436	5,880	6,380	3,964	4,040
August	3,445	3,107	9,000	17,808	12,445	20,915	7,343	6,849	4,734	4,335
September	3,122	2,780	9,000	11,468	11,822	14,248	6,136	6,299	3,819	3,821
October	2,622	2,635	8,700	13,040	11,622	15,675	5,608	5,777	3,570	3,374
November	2,321	2,468	9,000	12,073	9,321	14,541	5,739	6,867	3,693	4,240
December	2,681	2,267	7,000	10,414	8,681	12,681	6,340	6,477	3,999	4,071
Total	33,079	31,990	91,200	140,157	124,239	172,147	67,172	73,613	43,488	45,680

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS

(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil *	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
4. 7.60	30.75	48.00	300.00	310.00	46.00	8.75	14.00	15.00
18. 7.60	30.75	50.00	295.00	305.00	45.00	8.75	14.00	15.00
25. 7.60	30.75	51.00	307.50	317.50	46.00	8.62½	14.00	14.50
2. 8.60	31.00	51.00	300.00	310.00	45.00	8.62½	14.00	14.00
8. 8.60	31.50	49.50	310.00	320.00	46.00	8.75	14.00	16.50
15. 8.60	31.50	49.25	320.00	330.00	45.00	8.62½	14.00	13.50
22. 8.60	30.50	48.00	305.00	310.00	46.00	8.87½	14.00	15.00
29. 8.60	30.00	47.00	302.50	312.50	47.50	8.75	14.00	16.00
5. 9.60	30.25	46.50	270.00	280.00	47.00	8.87½	14.00	16.00
12. 9.60	29.75	46.00	280.00	290.00	47.00	9.00	14.00	16.00
26. 9.60	29.00	45.25	257.50	267.50	46.00	8.87½	13.00	16.00
3.10.60	28.75	44.50	235.00	245.00	45.00	9.00	13.00	16.00
10.10.60	27.75	44.25	229.00	239.00	46.00	9.12½	13.00	16.00
17.10.60	27.75	44.00	242.00	252.50	46.00	9.25	13.00	15.00
24.10.60	27.75	45.50	245.00	255.00	46.00	9.37½	12.00	15.00
7.11.60	28.62½	45.00	260.00	264.00	46.00	9.25	12.50	15.00
14.11.60	28.25	45.25	270.00	280.00	46.00	9.25	12.50	15.50
21.11.60	28.00	45.00	257.50	267.50	46.00	9.25	12.50	14.75
28.11.60	27.50	44.00	260.00	270.00	46.00	9.12½	12.50	14.75
5.12.60	27.50	43.50	245.00	255.00	46.00	9.37½	12.50	13.50
12.12.60	26.75	43.00	235.00	245.00	46.00	9.62½	12.50	14.25
27.12.60	26.25	43.00	235.00	245.00	46.00	9.62½	13.00	14.25

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

† 1 pikul = 133⅓ lb.

* F.O.B. in second-hand drums.

Table VIII

MALAYAN AGRICULTURAL EXPORTS, JANUARY TO DECEMBER, 1960. ‡

Product	Net Exports in Tons			
	* Year 1957	* Year 1958	§ Year 1959	§ Year 1960
Arecanuts	9,625	4,938	6,941	2,178
Coconuts, fresh †	37,446	52,340	104,935	109,570
Coconut oil	100,031	67,483	27,641	27,378
Palm Oil	56,728	67,818	71,103	90,545
Pineapples, canned	37,671	41,417	27,119	32,823
Sago, flour	15,581	21,652	681	1,623
Tapioca, flake	403	350	122	628
Tapioca, pearl	5,222	3,333	1,765	12,498

‡ Statistics compiled from "Federation of Malaya, Statistics of External Trade". December, 1960.

* Figures for 1957—58 include Singapore.

§ Figures for 1959—1960 exclude Singapore.

† hundreds.

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes								Number of Days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	90.5	73.2	81.9	93.8	71.0	83.9	75.4			4.27	108.5	1.30	14	11	6			205.55	6.63	
Kuala Lumpur, Selangor	90.5	73.8	82.1	95.2	69.0	83.9	76.8	84.2	85.7	7.31	185.7	1.35	15	14	8	3		209.30	6.75	
Sitiawan, Perak	89.7	73.2	81.5	94.2	70.6	83.2	76.9	84.6	86.0	3.50	88.9	0.86	12	10	8	3		212.40	6.85	
Kuantan, Pahang	88.7	72.0	80.3	90.2	68.8	82.6	74.9	83.7		5.58	141.7	1.55	13	10	8	4		188.30	6.07	
Bayan Lepas, Penang	88.1	74.2	81.1	91.8	72.2	83.6	77.0			11.46	291.1	3.65	18	17	10			217.35	7.01	
Malacca	86.7	72.8	79.7	90.1	69.1	83.0	75.8			9.77	—	2.05	17	15	9			186.75	6.02	
Mersing, Johore	88.0	71.8	79.9	90.8	69.6	82.0	74.0			7.47	189.7	1.28	15	12	11			209.55	6.76	
Alor Star, Kedah	89.3	74.4	81.9	83.2	72.1	84.6	77.4			11.74	298.2	2.06	23	21	6			226.40	7.30	
Kota Bharu, Kelantan	88.6	74.3	81.5	92.9	71.0	84.2	77.0	86.4	87.3	10.41	264.4	2.65	13	10	7			235.25	7.59	
K. Trengganu, Trengganu	88.1	73.3	80.7	91.3	68.8	84.7	75.2			3.17	80.5	0.95	10	9	1			223.10	7.20	
Singapore	87.0	74.6	80.8	89.7	72.6	82.2	79.0			4.31	109.5	1.01	16	10	9	2		150.40	4.85	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	73.3	56.2	64.7	82.4	49.8	69.6	61.0			6.01	152.7	1.26	17	13				135.45	4.37	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total	Most in a day	Number of Days						Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	°F	°F		Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more				
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	92.4	73.5	82.9	97.0	69.0	87.8	76.4			4.22	107.2	1.02	14	12	8			229.75	7.41	
Kuala Lumpur, Selangor	91.0	74.1	82.5	93.9	70.7	87.3	76.0	84.2	85.4	7.34	186.4	2.10	14	12	7			199.70	6.44	
Sitiawan, Perak	91.2	73.7	82.5	93.4	70.2	87.6	75.6	85.6	86.3	2.46	62.5	1.03	7	6	2			225.50	7.27	
Kuantan, Pahang	90.3	72.9	81.6	93.3	69.5	84.4	76.3	83.6		8.34	211.8	2.61	13	12	10	1		199.80	6.45	
Bayan Lepas, Penang	88.4	74.4	81.4	91.7	71.2	82.7	77.1			6.36	161.5	1.77	17	16	13			194.20	6.26	
Malacca	87.6	73.3	80.5	90.3	70.2	81.7	74.9			4.60	116.8	1.16	13	12	9			194.50	6.27	
Mersing, Johore	88.0	72.3	80.1	90.9	69.6	82.0	74.2			5.36	136.1	1.01	22	18	13			185.20	5.97	
Alor Star, Kedah	88.2	75.0	81.6	91.1	72.4	78.2	78.0			9.39	238.5	2.61	19	14	6	1		201.05	6.49	
Kota Bharu, Kelantan	88.7	74.9	81.8	90.2	72.4	86.6	77.9	85.2	81.9	6.42	163.1	1.86	15	15	13	1		216.90	7.00	
K. Trengganu, Trengganu	88.7	74.3	81.5	91.1	71.6	86.1	76.9			5.16	131.1	1.60	13	11	6			204.15	6.59	
Singapore	88.7	75.6	82.1	91.1	71.9	81.8	79.2			2.06	52.3	0.78	12	7	10	4		186.20	6.01	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang, (4750 ft.)	73.1	57.1	65.1	76.4	51.0	70.0	62.6			6.98	177.3	1.65	16	14				148.90	4.80	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes									Number of Days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot ° F	At 4 feet ° F	Total		Most in a day Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	91.6	72.9	82.3	94.2	70.3	87.3	74.4			7.25	184.2	1.63	16	16	10			189.65	6.32	
Kuala Lumpur, Selangor	90.5	74.2	82.3	93.0	70.5	85.9	76.7	84.4	85.5	9.30	236.2	3.79	11	9	7			204.45	6.81	
Sitiawan, Perak	89.0	72.8	80.9	92.6	70.7	83.8	75.0	84.2	85.5	7.99	202.9	4.31	15	10	5			174.35	5.81	
Kuantan, Pahang	89.0	72.2	80.6	91.5	70.5	84.3	75.2	82.9		10.75	254.0	1.99	19	17	18	6		174.85	5.83	
Bayan Lepas, Penang	87.7	74.1	80.9	90.5	71.5	83.9	76.6			8.97	227.8	1.51	19	18	12			174.05	5.80	
Malacca	87.5	73.2	80.3	89.9	69.9	82.7	76.0			7.99	202.9	3.16	14	13	9			177.90	5.93	
Mersing, Johore	87.9	71.4	79.7	90.8	69.4	82.9	73.4			11.17	283.7	2.42	22	18	11			164.80	5.49	
Alor Star, Kedah	87.5	74.3	80.9	91.1	72.3	81.3	76.8			16.99	431.5	3.00	23	20	7			199.00	6.63	
Kota Bharu, Kelantan	88.4	74.1	81.3	91.3	72.6	86.0	76.2	86.6	87.1	4.41	112.0	2.17	14	10	7			215.60	7.19	
K. Trengganu, Trengganu	88.3	73.1	80.7	90.8	70.5	85.1	75.1			4.87	123.7	1.44	12	9	5			206.55	6.89	
Singapore	87.9	74.5	81.2	91.0	72.4	83.0	76.8			5.80	147.3	1.80	15	13	11			154.00	5.13	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang, (4750 ft.)	73.0	56.5	64.7	77.0	49.0	69.8	60.8			10.04	255.0	2.06	26	22				143.05	4.77	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days						Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.					Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more				
								o F	o F	in.	mm.	in.							hr.	hr.	
Ipoh, Perak	91.6	73.0	82.3	96.2	70.5	86.0	75.7			6.38	162.1	1.54	16	15	7				203.25	6.56	
Kuala Lumpur, Selangor	89.6	73.6	81.6	94.1	70.0	81.2	75.5	84.7	85.9	9.73	247.1	2.14	19	17	13	4			187.80	6.06	
Sitiawan, Perak	88.3	72.7	80.5	91.6	70.2	83.0	74.9	84.5	85.6	6.04	153.4	1.61	19	16	10	2			188.15	6.07	
Kuantan, Pahang	89.2	72.0	80.6	93.8	69.0	82.3	75.3	83.5		6.35	161.3	1.58	15	9	8	9			179.00	5.77	
Bayan Lepas, Penang	87.7	74.4	81.1	90.5	72.1	85.4	72.5			5.55	141.0	1.36	17	11	10				187.70	6.12	
Malacca	87.7	73.2	80.5	90.4	71.8	82.1	75.5			7.34	186.4	2.22	20	14	14				198.15	6.39	
Mersing, Johore	88.6	71.6	80.1	92.3	69.7	80.3	74.0			9.30	236.2	2.04	17	14	11				203.55	6.57	
Alor Star, Kedah	88.7	74.1	81.4	91.2	71.7	82.2	76.7			5.31	134.9	2.21	16	9	6				220.20	7.10	
Kota Bharu, Kelantan	87.9	74.3	81.1	94.5	72.8	77.6	77.0	86.6	87.6	13.05	331.5	2.91	15	14	1				181.70	5.86	
K. Trengganu, Trengganu	87.4	73.5	80.5	91.8	71.3	74.5	76.1			8.79	223.3	1.72	13		1				172.45	5.56	
Singapore	89.1	74.5	81.8	91.9	72.1	81.1	72.1			2.48	63.0	1.03	11	7		13			178.35	5.75	
HILL STATION																					
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.8	55.7	64.3	76.8	50.2	68.8	60.2			7.33	186.2	1.91	22	20					162.20	5.23	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	89.0	72.7	80.9	93.0	69.6	82.7	75.0			15.08	383.0	2.96	20	19	8			139.10	4.64	
Kuala Lumpur, Selangor	87.8	74.0	80.9	92.5	71.9	80.0	76.0	83.5	85.1	9.34	237.2	2.23	22	20	8	1		146.75	4.89	
Sitiawan, Perak	86.5	72.9	79.7	90.3	69.8	78.7	75.2	83.3	84.9	7.25	184.2	1.06	22	19	4	3		146.60	4.89	
Kuantan, Pahang	85.4	72.2	78.8	89.6	70.0	76.4	74.5	82.0		9.86	250.4	1.18	24	21	14	17		108.20	3.61	
Bayan Lepas, Penang	86.0	73.7	79.9	90.1	71.3	80.0	79.0			11.47	291.3	1.36	21	17	4			141.70	4.72	
Malacca	86.6	73.3	79.9	91.2	72.0	80.8	75.9			11.12	282.4	2.06	19	16	6			127.90	4.26	
Mersing, Johore	85.5	72.0	78.7	90.8	70.3	77.8	73.4			10.34	262.6	2.00	22	17				133.85	4.46	
Alor Star, Kedah	86.6	73.2	79.9	92.3	71.2	77.2	75.4			7.87	200.4	1.57	22	19	8	1		155.65	5.19	
Kota Bharu, Kelantan	82.9	74.0	78.5	89.6	72.2	75.6	75.8	79.6	80.0	31.27	794.3	9.11	27	24	2			124.90	4.16	
K. Trengganu, Trengganu	83.3	73.3	78.3	90.0	71.8	74.9	75.2			31.87	809.5	7.96	24	19				143.20	4.77	
Singapore	87.2	74.3	80.7	91.6	71.1	81.3	76.2			4.13	104.9	2.28	17	12	8			122.60	4.09	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang, (4750 ft.)	71.2	57.3	64.3	76.0	50.2	68.0	62.0			11.18	284.0	1.66	24	23				93.45	3.11	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, DECEMBER, 1960

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	°F	°F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	90.6	72.6	81.6	94.1	70.0	82.2	75.2			11.33	287.8	3.94	19	17	6			203.30	6.56	
Kuala Lumpur, Selangor	88.7	73.5	81.1	93.2	71.5	82.1	75.0			13.12	333.2	3.01	23					—	4.87	
Sitiawan, Perak	87.4	72.9	80.1	91.1	70.6	82.7	75.1	82.5	83.2	13.72	348.5	4.30	19	18	6	3		189.35	6.11	
Kuantan, Pahang	83.7	71.3	77.5	88.4	68.8	75.1	73.2			30.49	774.4	11.60	25	22	4			125.25	4.04	
Bayan Lepas, Penang	88.3	73.7	81.0	91.7	70.3	85.2	76.5			2.73	69.3	0.71	14	11	5			223.90	7.22	
Malacca	86.5	72.7	79.6	90.8	71.0	78.1	75.0			9.73	247.1	2.18	13	12	6			141.80	4.57	
Mersing, Johore	81.7	72.6	77.1	86.2	69.9	74.6	76.8			40.41	1026.4	13.99	28	23				127.65	4.12	
Alor Star, Kedah	88.6	72.1	80.3	91.2	68.6	82.7	74.2			1.27	32.3	0.34	10	7				212.30	6.85	
Kota Bharu, Kelantan	83.8	74.2	79.0	86.8	72.1	78.0	77.7	80.7	81.9	25.01	635.3	6.97	27	26		1		156.30	5.04	
K. Trengganu, Trengganu	83.2	73.4	78.3	85.4	71.3	79.8	76.3			12.70	322.6	2.76	27	23				140.50	4.53	
Singapore	86.4	74.1	80.3	90.8	71.8	78.2	76.2			7.04	178.8	2.01	19	12	8			137.85	4.45	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	71.4	56.7	64.0	75.0	50.8	68.0	62.0			8.05	204.5	2.81	19	13				122.55	3.95	

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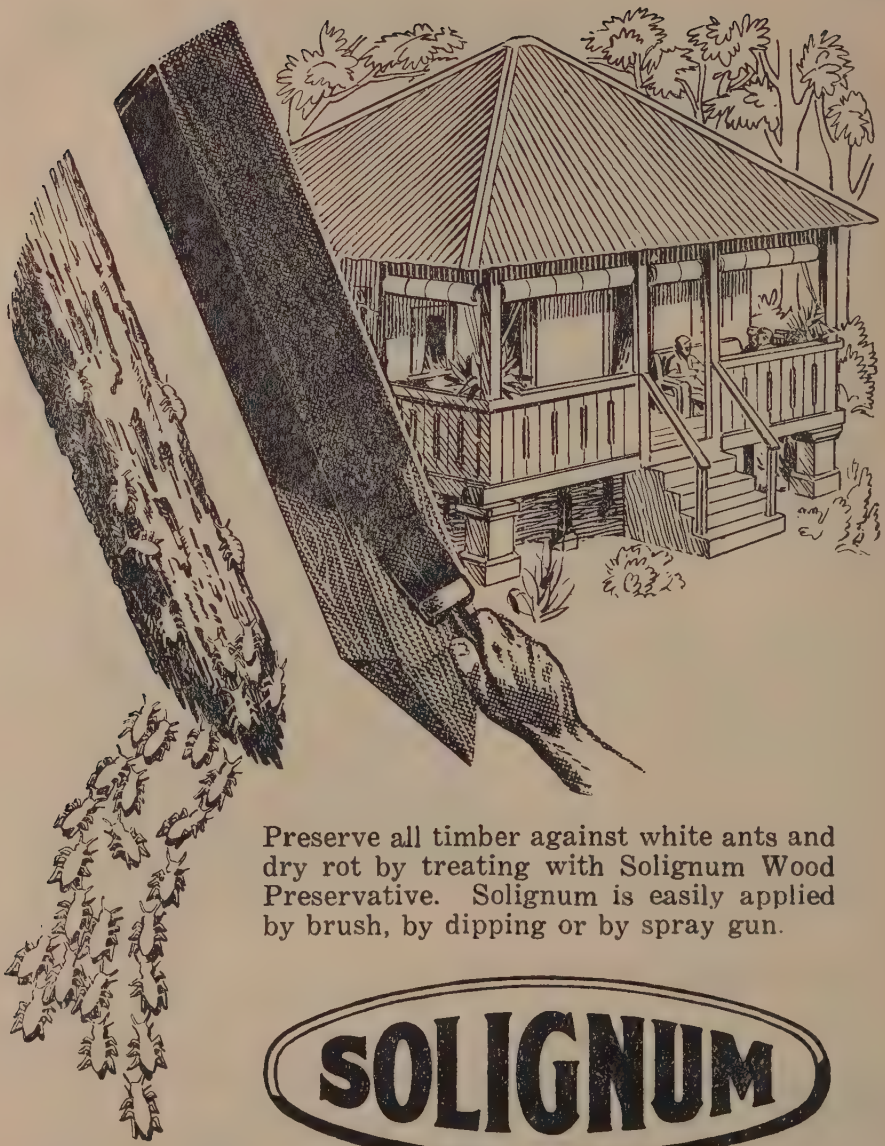

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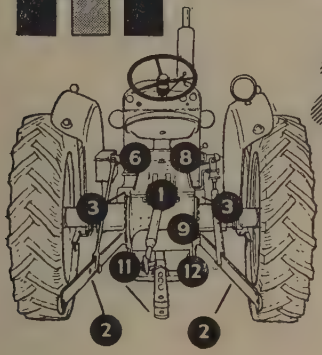

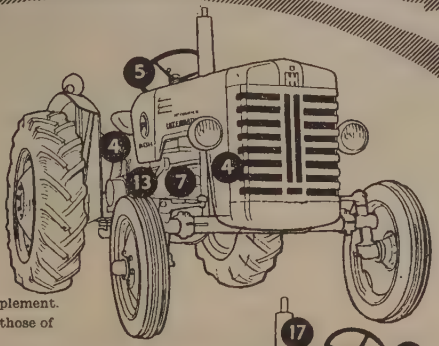

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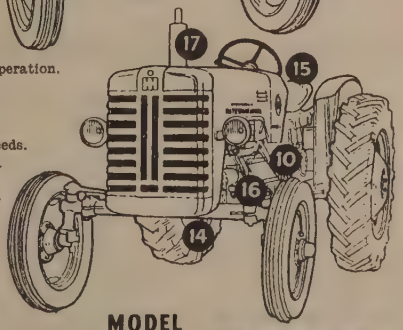

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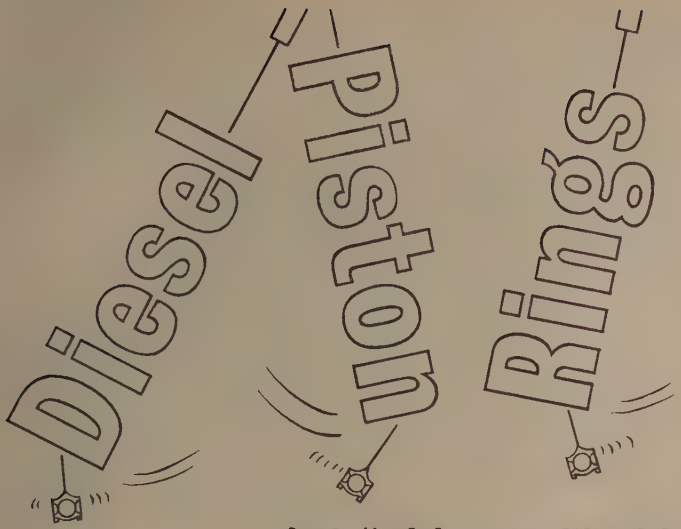

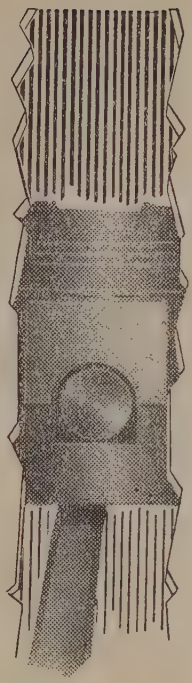

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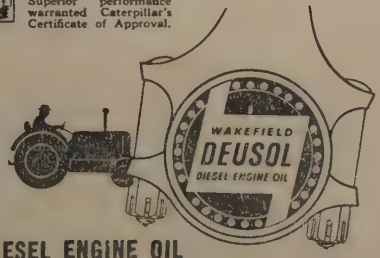

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